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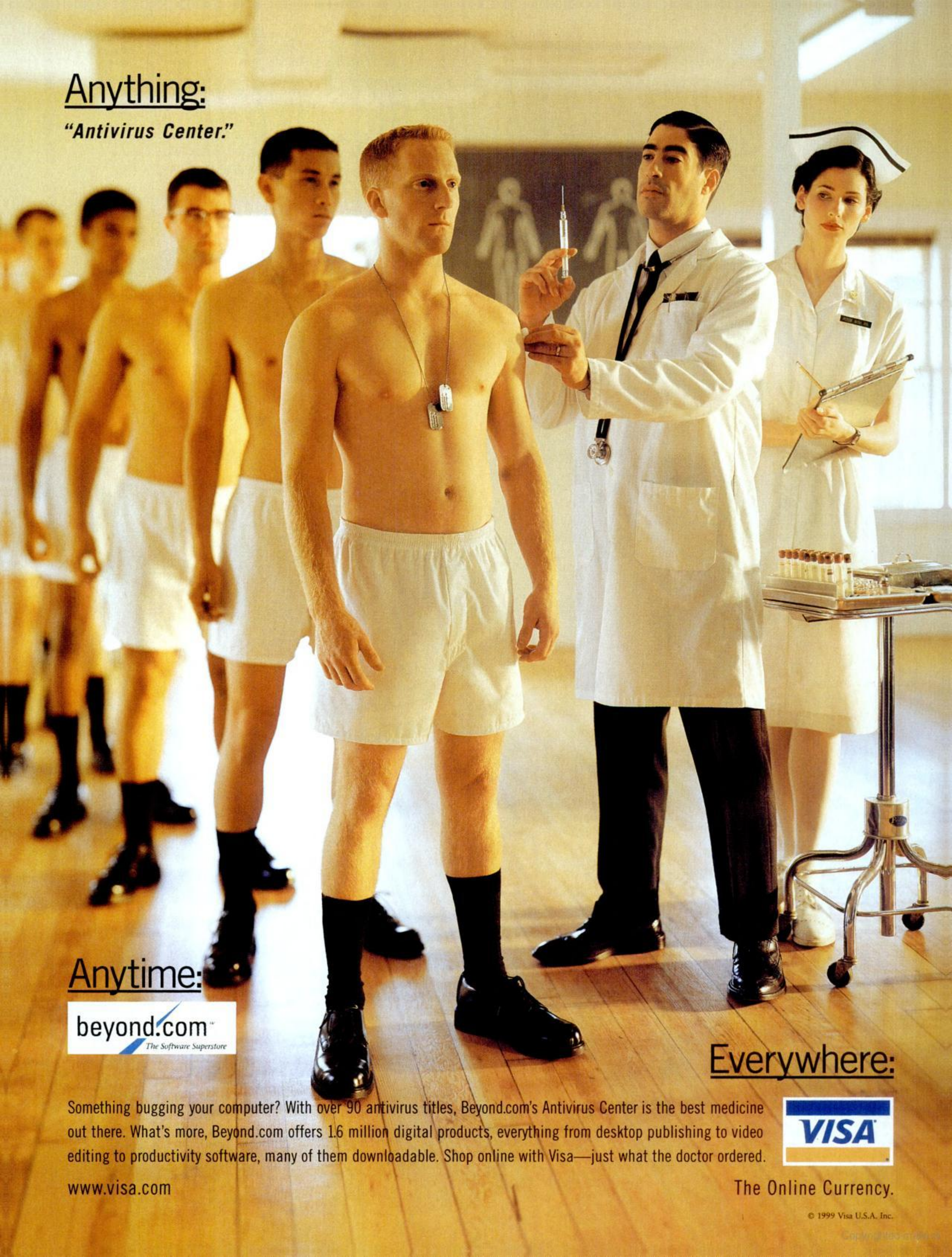
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JUNE 2000

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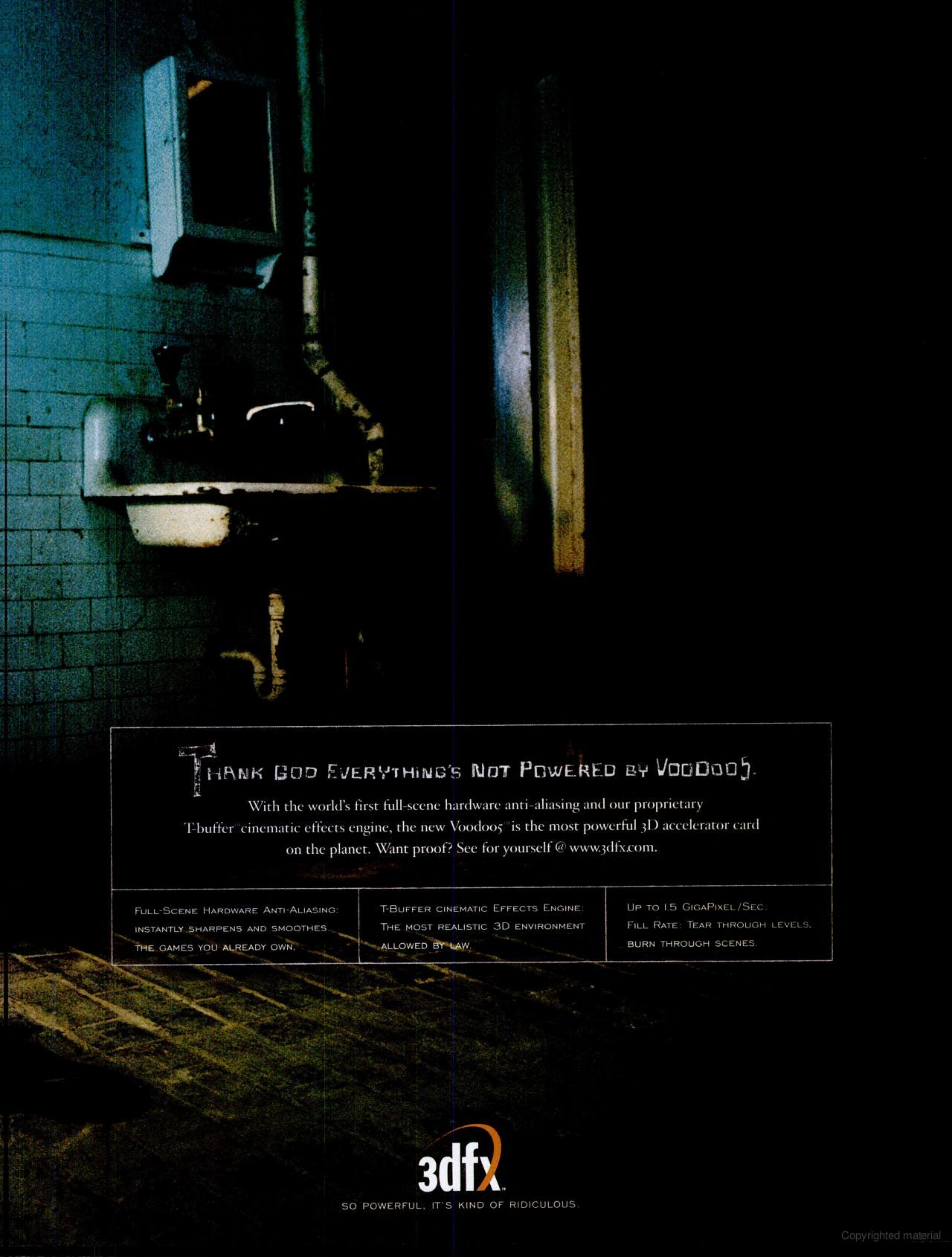

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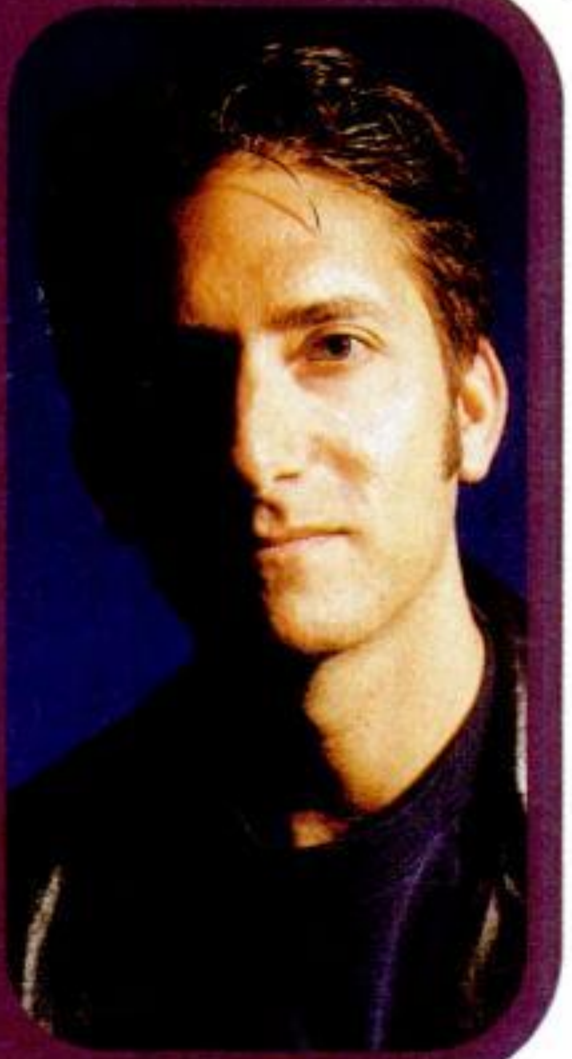
EDWORD

Has the Jury Reached a Verdict?

The day after we put an issue of the magazine to bed, I grab the three-ring binder that contains the issue's color page proofs and begin logging verdicts. This is usually a thoroughly enjoyable task. Like all *Maximum PC* editors, I take pride in callin' em like I see 'em, and dishing out low verdicts to feeble products that deserve to be dinged.



While peeling through the May issue, however, I was alarmed to discover that we had awarded a bounty of high verdicts—to be precise, nine 8 verdicts and eight 9 verdicts out of 20 total reviews. True enough, we also awarded one middling 7, one unforgiving 4, and one punishing 2, but overall, it looks as though we gave the vendors a free pass for the month of May. And this hurts more than road rash from rough-cut gravel.

While a product might be strong in and of itself, if it's still just the third or fourth best in its category, there's no reason it should receive a high verdict.

Maximum PC lives and dies by its reputation for uncompromising reviews. We don't care who currently advertises in the magazine, or who might eventually advertise in the magazine. If your product is bad, it will be slammed. And not even a low price can save a product from a low verdict. Other magazines have been playing the "it may not be the best, but it sure is cheap" card for years, and as most *Maximum PC* readers already know, this philosophy doesn't pan out when you bring a component home from Fry's and discover it can't deliver when running your most demanding applications.

So what happened in the May issue? You can assign half the blame to coincidence. Sometimes, a bunch of incredible products roll into the Lab all at once. The rest of the blame can be assigned to the magazine's expensive tastes. Because we place cutting-edge power and performance on a lofty pedestal, we usually reject offers to review "budget" products. We have no interest in 17-inch monitors, 5400rpm hard drives, and systems with last season's videocard and CPU. Yet, if we actually reviewed these lower-echelon products, they'd be judged against the best products available in the same category, and receive damning verdicts as a result.

One reader suggested that we arbitrarily lower our verdict scaling to "protect our reputation." This strategy has allure, but it's ultimately unfair to the product manufacturers and taints the integrity of our verdict scale. So what's the solution? As a group, our best strategy is to test as many products as possible, and use the magazine as a platform to expose products that no one should invest in. As individual reviewers, our best strategy is to constantly ask ourselves if we're being too forgiving of a product's inadequacies. After all, while a product might be strong in and of itself, if it's still just the third or fourth best in its category, there's no reason it should receive a high verdict. Bottom line: If we wouldn't recommend it to our friends, then we certainly shouldn't give it the endorsement of any verdict higher than 7.

What happened this month? We dished out four 7s, three 6s, one 5, one 4, and one 3. See, things are already looking up! Or down, if you happen to be a vendor and are standing on the other side of the product fence.

—Jon Phillips, editor-in-chief

MAXIMUM PC
JUNE 00 vol5 Issue6

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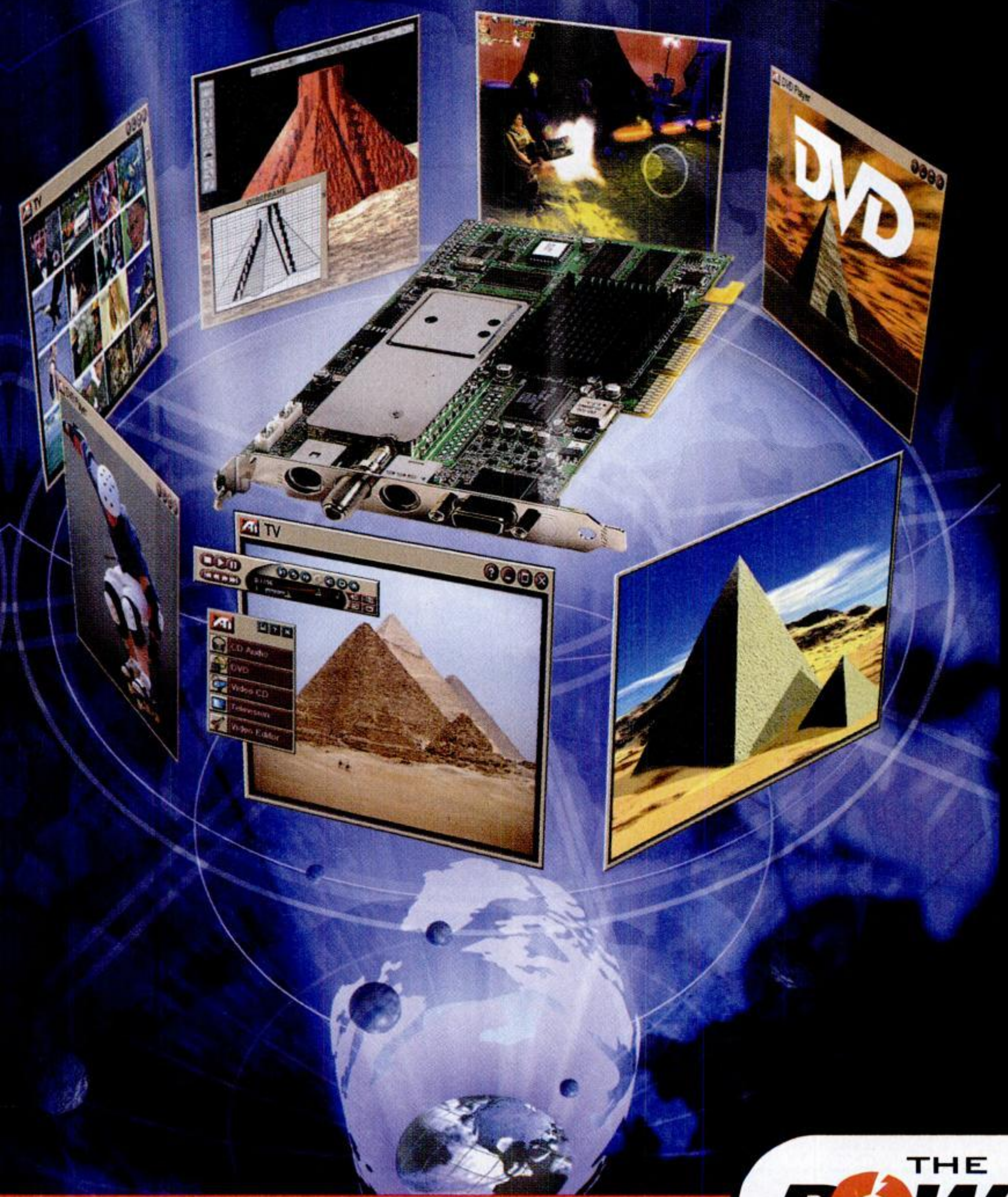
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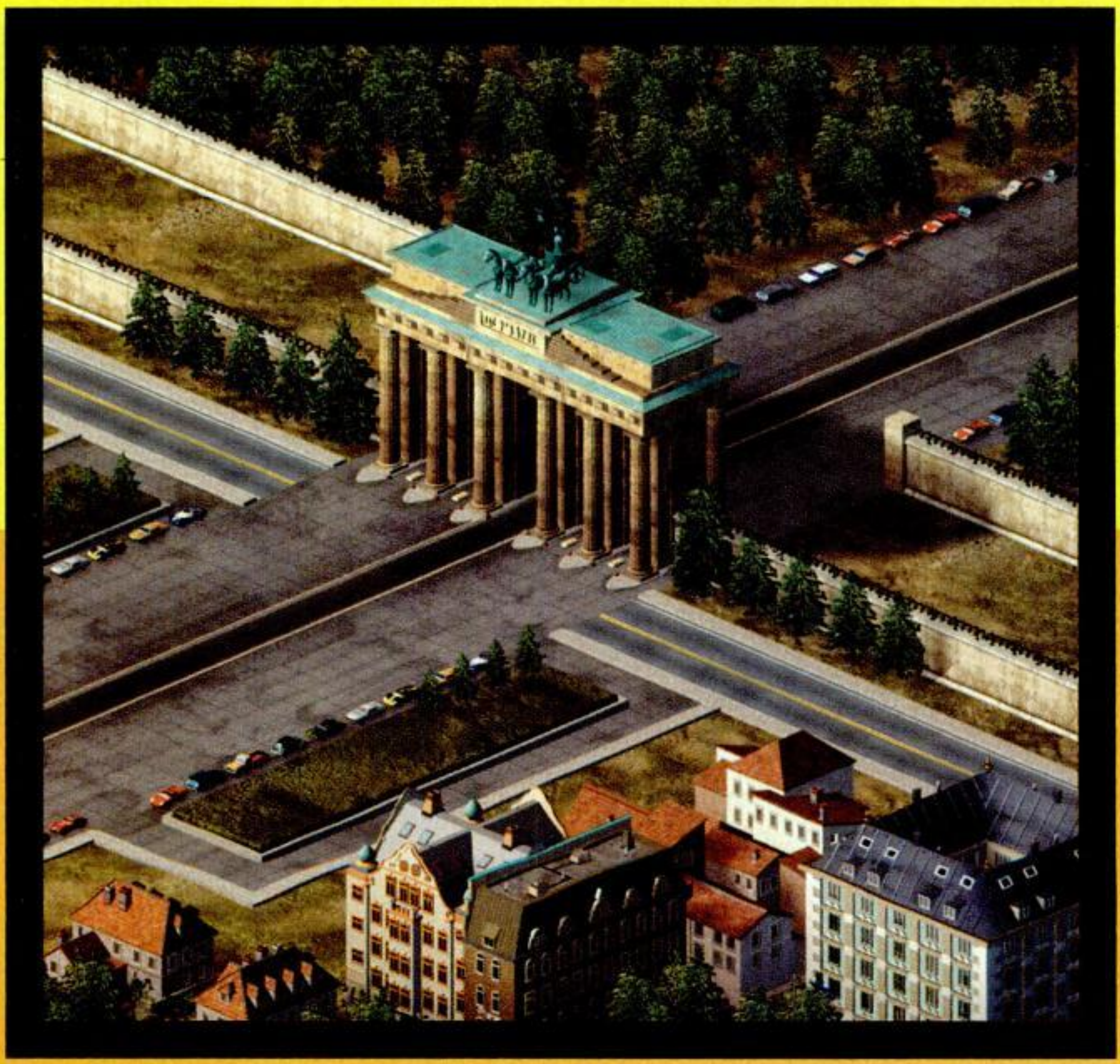

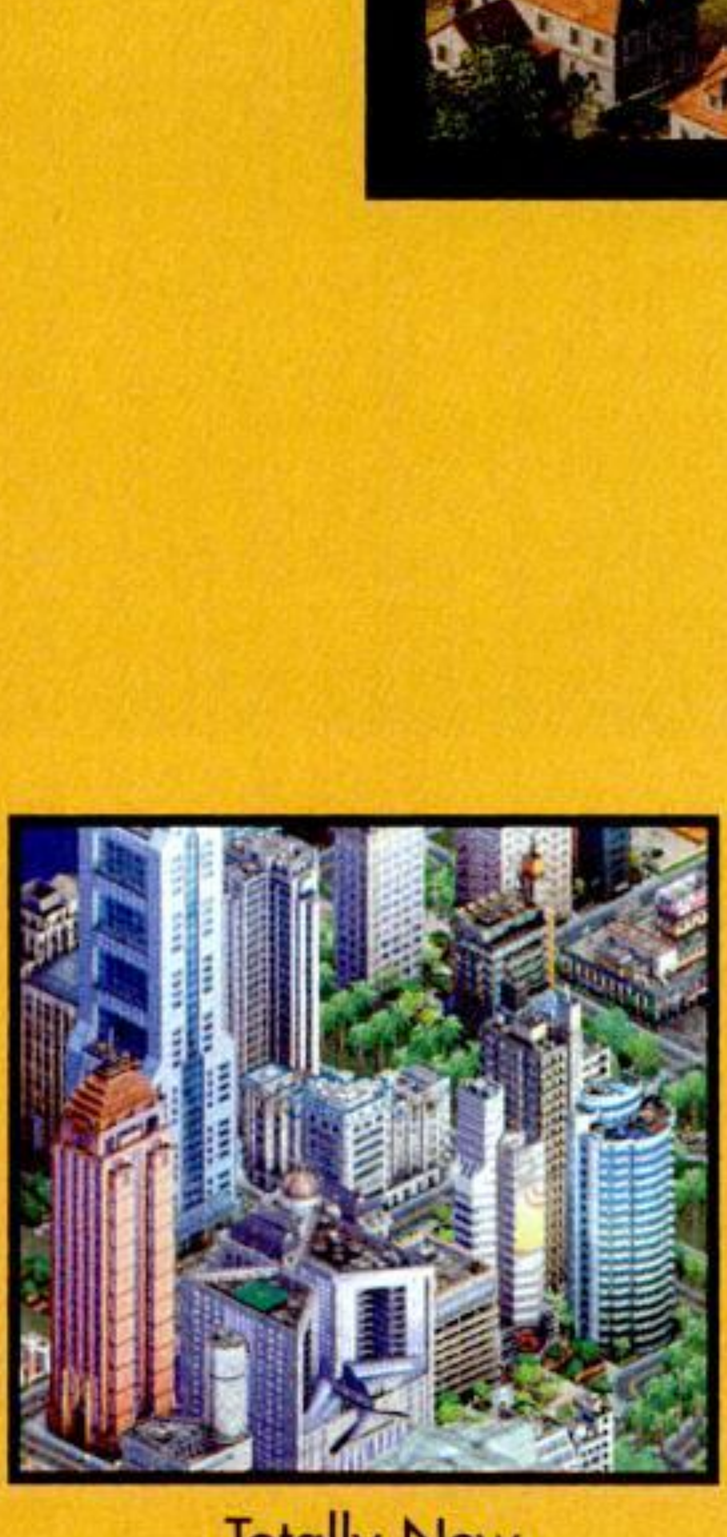

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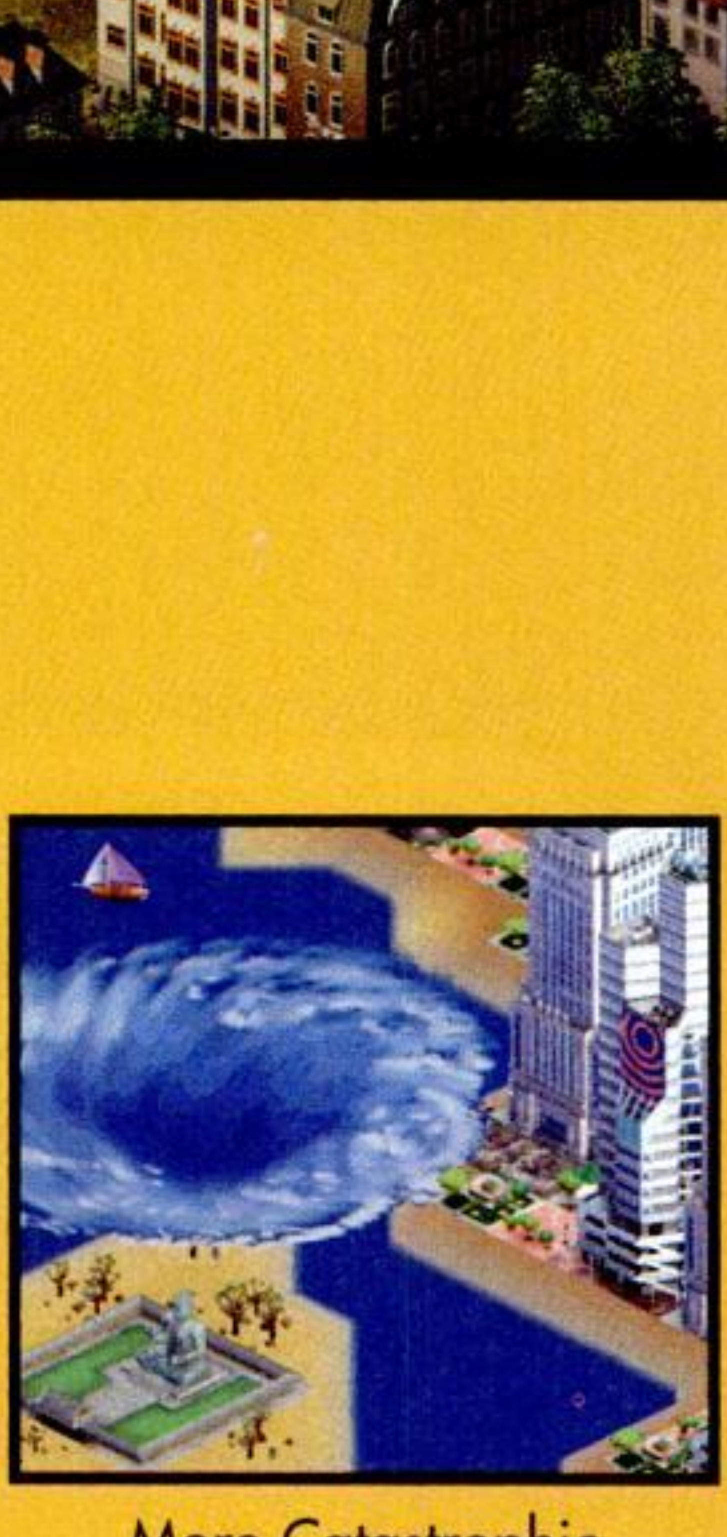

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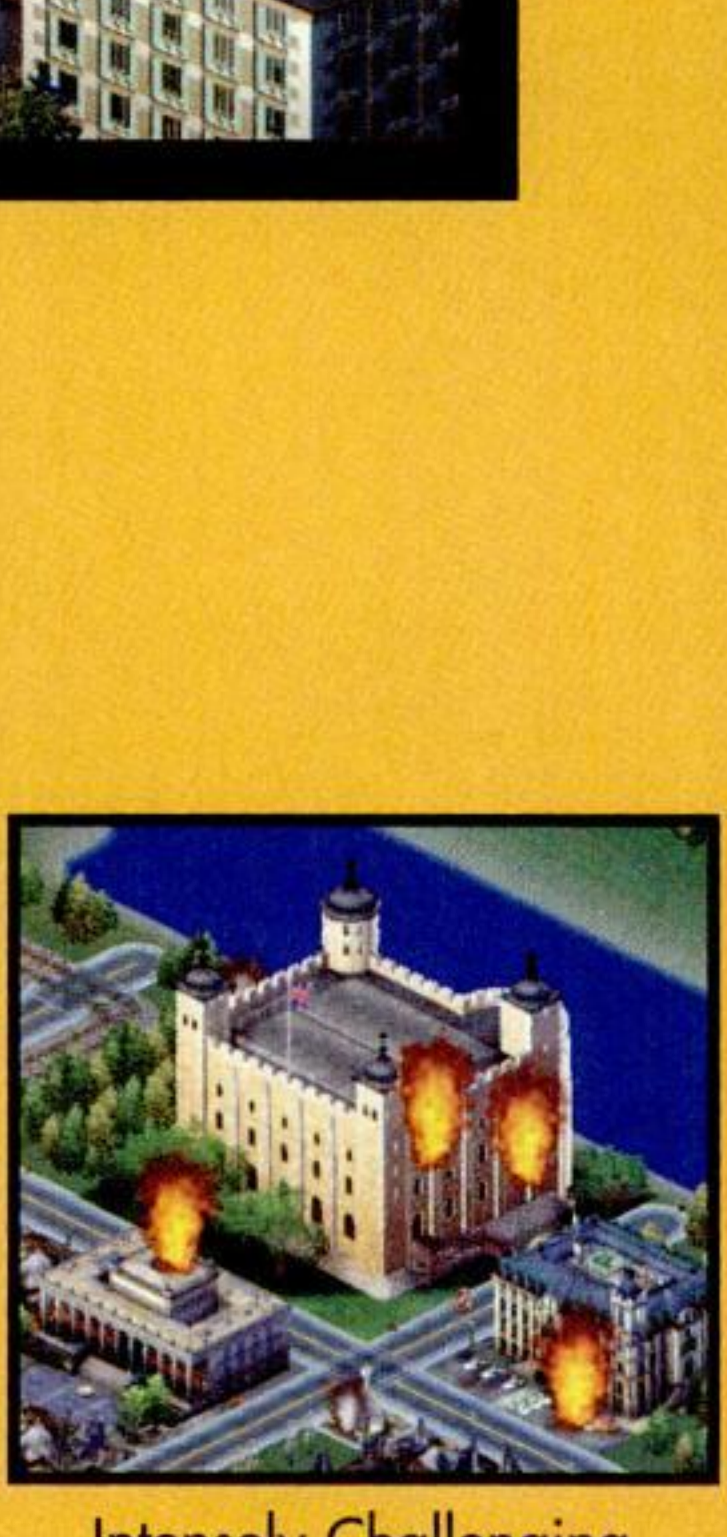

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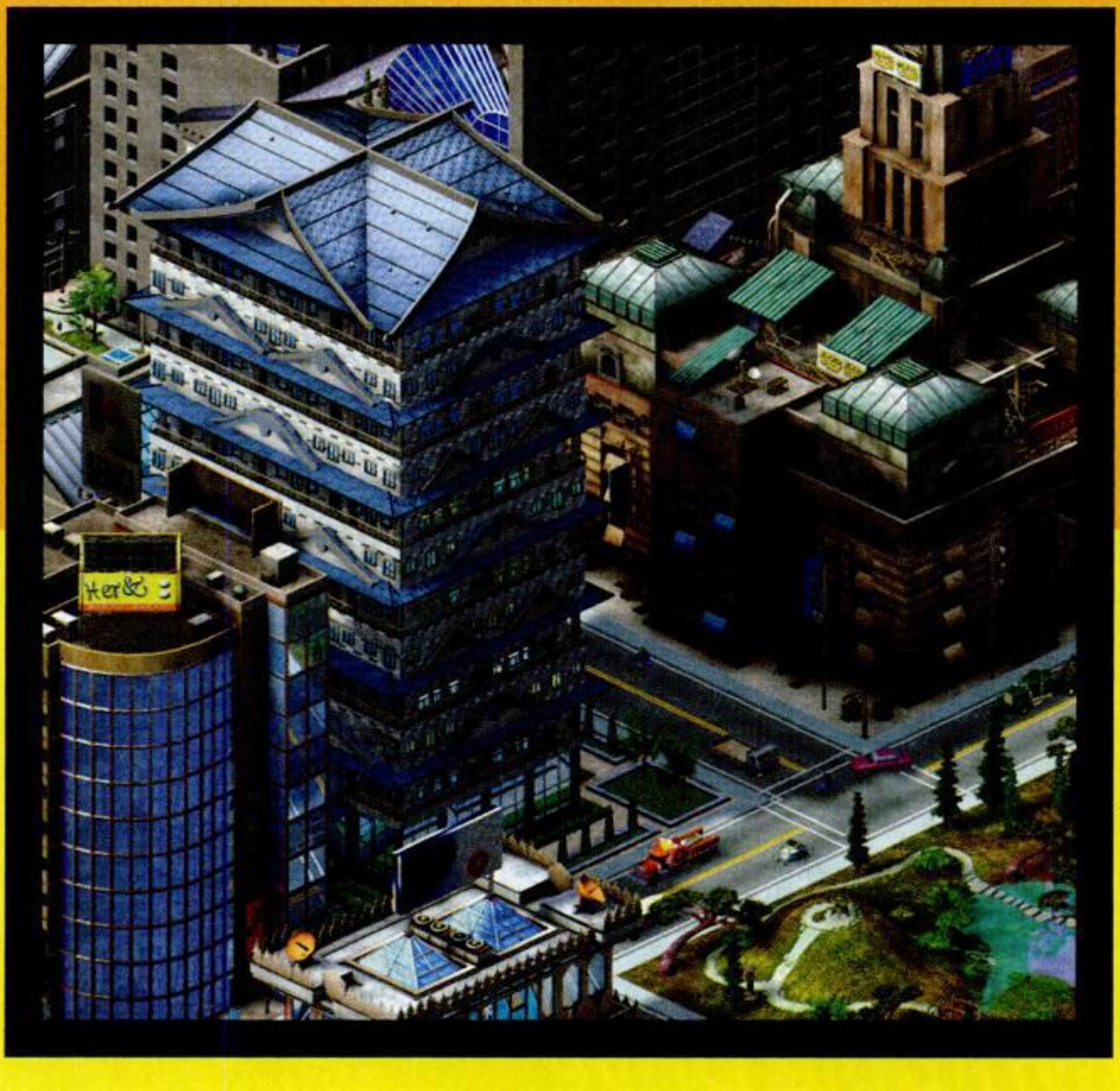

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r

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The Maximum PC Reader Is a Nocturnal Hunter

According to much of the e-mail we've received recently, the April issue was a big hit. Anecdotal evidence says you want to learn more about cooling and power strategies, BIOS tweaks, and symmetric multiprocessing. We also discovered that when we ratchet up the content to geek-factor 8 or 9, the eagle-eye tech mavens swoop down from their perches and pick apart our articles. We start this month's Commport section with some Windows 2000 feedback.

Win2000 Retorts

I found a couple of dumb mistakes in the April issue Windows 2000 article:

▶ "NT... is incapable of running 16-bit applications." This is idiotic. I run a number of 16-bit applications under NT every bloody day.

▶ "Win98 users who wanted to make the move to NT were forced to format their hard drives..." Oh, please. Anybody sufficiently with-it to be reading *Maximum PC* in the first place has surely heard of *Partition Magic.*

—David L. Staples

Recognize that I was (and still am) a beta tester for Microsoft on Win2000. I've used it since pre-beta 1. To that end, I was very disappointed in some of your reporting. You focused on things that aren't really all that big of a deal and then missed some of the most important features.

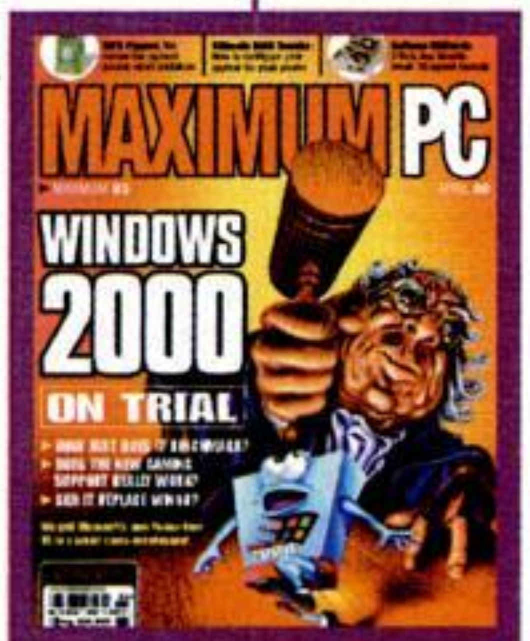
▶ File Protection in Win2000. You say that it is the same that ships with Win98. Not likely! Win98 has a half-assed system that forces the user to run protection, and then can kill your system if you do. Win2000 automatically protects files and replaces them on the fly so that the system can't be damaged.

▶ You recommend that a person copy the i386 directory to his hard drive for drivers and such. This is just plain wrong! Yes, in Win98 this was a good idea because there was no driver cache. But Win2000 keeps all the drivers on your hard drive to start with, in the driver.cab file (winnt\driver cache\driver.cab), and will install them from there. Often, you won't even know that Win2000 has installed new hardware because it gets drivers from there. In addition, all system-protected files are kept in the dllcache directory in system32. As a result, it is very unlikely that you will ever be prompted to insert the Windows 2000 CD. So you don't need to waste 300MB of space on your hard drive on the i386 directory, because you'll never need it.

▶ You use nVidia cards for your testing. Wonderful! Except, nVidia drivers suck in Win2000 compared to Win98. Matrox Win2000 drivers (of which there have been excellent beta drivers since early December 1999, and final drivers five days before Win2000 was officially released) score almost identically in Win98 and Win2000. In fact, Win2000 drivers are often faster. nVidia and 3dfx are still working on beta drivers (I write this despite 3dfx's claim that the crap they have out now are final drivers). nVidia is still two-to-four weeks away (as of this writing) from having a real final driver out, and it still won't be able to keep up with the Win9x drivers.

▶ SMP does not need more RAM to perform better! The only reason you need more RAM is because you have more programs open—which is a function of the type of user you are if you have an SMP box, not the SMP requirement, or anything to do with Win2000. More memory helps dual- and single-proc machines equally well, percentage-wise.

—James Hancock



nVidia drivers suck in Win2000 compared to Win98.

FYI: Will Smith was reviewing the Pro version of Win2000—but the RAID Mirror and Striping functions are disabled in this version. You have to either run the server version or buy a RAID card.

—Dane Nelson

Contributing editor Will Smith and News editor Gordon Mah Ung reply: Let's address these issues one-by-one.

▶ The text should have read: "NT is incapable of running *many* 16-bit applications." We just wanted to convey that while most Win95/98 32-bit applications will run with 2000 (and NT), there is no guarantee that any 16-bit apps will work with the 16-bit code emulation that 2000 (and NT) provides.

▶ We are aware of *Partition Magic*, and have been fans of it for a while now. Nonetheless, resizing a FAT32 partition to 2GB and changing it to FAT16 or NTFS with *Partition Magic* is still reformatting. Our point here was that NT provides no easy upgrade path from 95 or 98. Instead, users are required to wipe out Windows and reinstall all their applications from scratch.

▶ We said that the same System File Checker that ships with Win98 also ships with Win2000—not that File Protection was the same. The back-end for system File Protection has indeed been changed, but there's still plenty of room for improvement. Many of the files that are automatically "protected" are simply in use and locked by the file system, and the most crucial files, like ntldr (which boots the OS), are completely unprotected.

We stand by our recommendation to copy the i386 directory to your hard drive, simply for

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convenience sake. 300MB isn't too big a sacrifice when you need to install something and can't find your CD-ROM.

▶ We asked Matrox, nVidia, 3dfx, S3, and ATI about driver support just prior to the release of Windows 2000, and printed their responses. Matrox simply stated that it would have a fully functional driver within a week or so of Win2000's release, while 3dfx and nVidia both stated that they'd release drivers on February 17. We defend our use of the GeForce 256 board in our testing. The GeForce is arguably the most popular gaming card on the market now and mindshare is behind it. Your point about mature drivers is well-taken, nonetheless, and we'll revisit Win2000 gaming performance soon.

▶ About SMP and memory requirements: Technically, David is correct—but what's the point of having a dual-proc box and only 64MB of RAM? Users who need more than one processor either use apps that take advantage of multiple processors (such as *Photoshop*) or multiple apps that each use their own dedicated processor. Either way, if you don't have enough RAM to gaussian blur a 60MB TIF file, or run *Word*, *Excel*, *Fireworks*, *Eudora*, and *Solitaire* out of memory, then your dual-proc system might as well be a single Pentium 90.

▶ Oops, you caught us, Dane. Striping and mirroring are only available in the Server, Advanced Server, and Datacenter versions.

To Sync or Not to Sync?

I have a Diamond Viper V770 Ultra and was wondering, what would be the benefits of turning off v-sync?

—John A. Nagle II

Features editor Sean Downey replies: To achieve smoother frame transitions in 3D games, your videocard places the frame that's just about to appear onscreen in its frame buffer (literally, the memory that sits on your card). Through a process of continuous swapping, the frame that appears on your monitor is replaced by the frame that was cued up in the buffer.

Enabling v-sync causes the videocard to synchronize buffer swaps with your monitor's fixed refresh rate—which might be 85Hz on a high-end monitor running at 1600x1200. As a result, frame rates with v-sync enabled never go past the refresh rate of the monitor. However, most videocards allow buffer swaps to occur without synching to the refresh rate, and this gives you faster frame rates at the expense of visual quality. When a videocard renders *without* synching to the refresh rate, anomalies such as image tearing mar the overall visual quality of a game.

Though most videocards are capable of running with v-sync disabled, many Display Properties control panels don't expose this feature. This is especially true of drivers found in PCs from major system OEMs, which strictly adhere to Microsoft's system edicts. We've found that most systems ship with v-sync enabled in Direct3D, which is required to pass WHQL, but disabled in OpenGL, which doesn't have the same requirement. If your drivers don't allow you to enable or disable v-sync through the advanced display settings, you can always use a utility such as Powerstrip (**www.entechtaiwan.com**) to turn it on and off.

AMD's Budget CPU

Just a quick question about the Spitfire: I have seen increasing amounts of information about this AMD processor; but I have yet to see anything about what motherboard will support it. Will we have to use slockets?

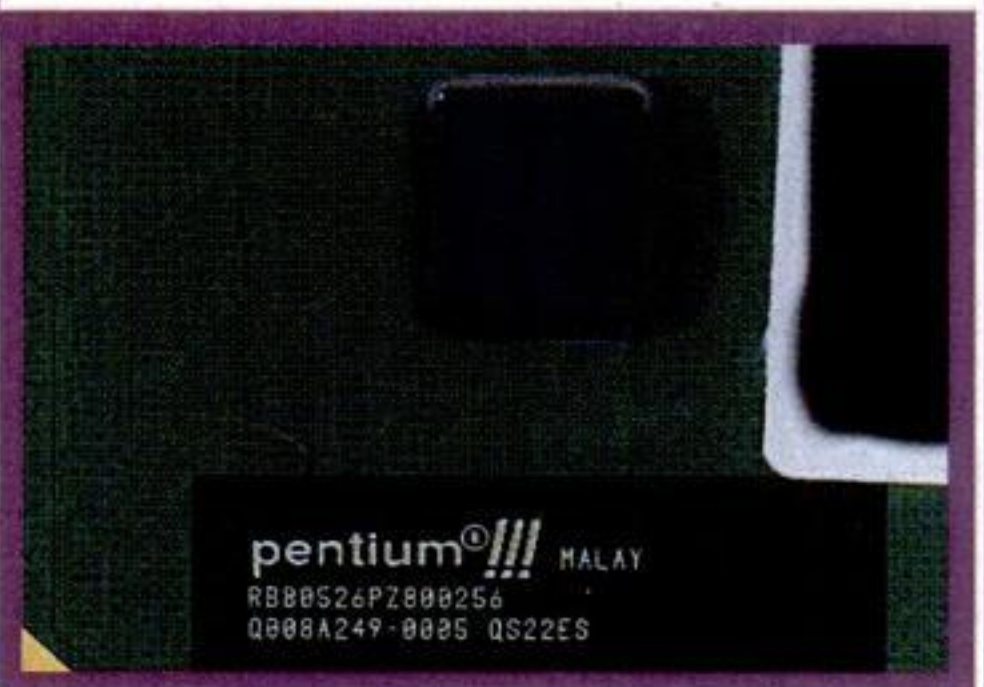
—Joe Tillman

News editor Gordon Mah Ung replies: Based on the Athlon core and a 0.18-micron process, this budget chip will offer on-die L2 cache and come exclusively in a socketed version. This new interface will be dubbed Socket A. AMD has yet to disclose either L2 amount or pin counts (thus, specific motherboard support is unknown). If you're currently a Slot A user, AMD expects you to pass up the budget Spitfire for Thunderbird. T-bird will be introduced at nearly the same time, and will feature more on-die L2 and ship in both Slot A and Socket A formfactors. Unlike Intel, which plans to see Slot 1 go away within a year or two, AMD officials told us they plan to offer performance CPUs in the slotted formfactor until demand disappears.

I've Found a Golden Ticket!

I am one of the fortunate few to have received, through an online retail purchase, a "golden" Pentium III with an unlocked multiplier. I noticed that in the March issue Ask the Doctor column, you pointed out that one should look for the label "Intel Confidential" on the processor to determine whether it is multiplier unlocked. On my FCPGA, I do not see anything like this, but do have the code "ES," which is a tip-off that the CPU is an engineering sample not meant for retail channels. Your picture in the March issue pointed this out.

I am able to safely bump the multiplier up from its supposed default of 6.0 to 6.5, with no problems. For some time prior to the purchase, I had been touting thevirtues of the Coppermine to the zealous AMD fans I work with. Perhaps the Intel gods have rewarded my allegiance by allowing for my good fortune to take place! In the photo I've submitted, I've fuzzed out the barcode because I think it is coding/tracking unique to the retailer. The important part is the QS22ES code, in particular "ES," for engineering sample. I hope Intel can't track this back to the retailer based on the coding in the pic.



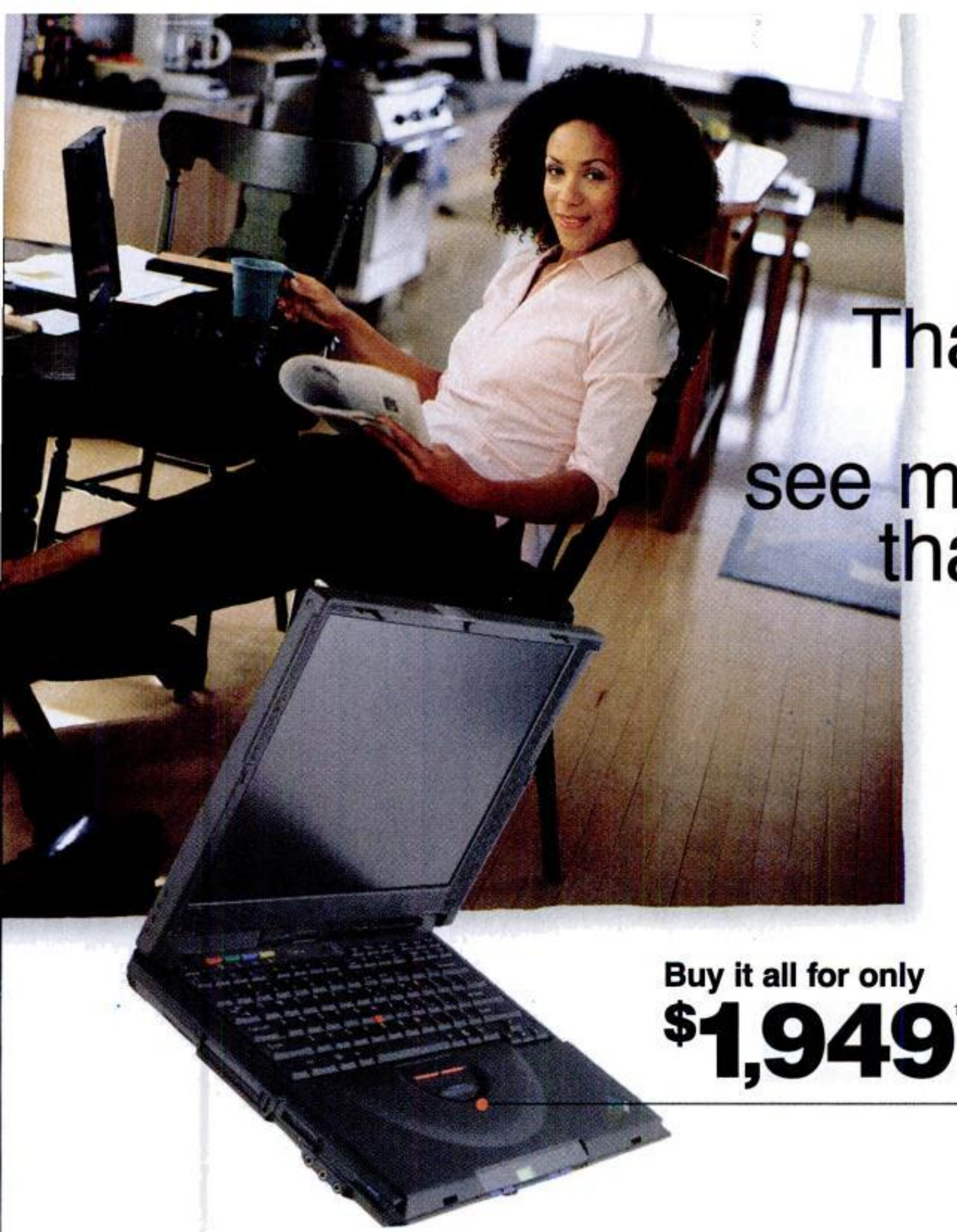
—Finneire

Editor-in-chief Jon Phillips replies: Let this be a lesson to all overclockers: Serendipity awaits the faithful. Now let's all rip open our PCs and check those serial numbers!

A Handy Upgrade

Can a regular handheld PC be converted to an actual PC? In the next month, I am going to purchase an HP Jornada 820, and I'm going to add a PCMCIA Type II hard drive. Next, I'm going to reformat the device and install Windows 98 or Windows 2000 onto the PCMCIA drive. If I can't install it on the drive, then I'll have to use an IBM 320MB microdrive. I'm not sure if this process is even possible, which is why I am writing to you. Can a handheld be reformatted? And can Win98/00 be installed on it?

—Jerry Billings



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Contributing editor Tom Halfhill replies: There are probably a dozen reasons why your plan won't work, but the biggest reason is that Windows 98 and Windows 2000 run only on x86-compatible processors, and the HP Jornada 820 has a StrongARM processor. Those CPU architectures are completely incompatible with one another. It would be like installing Windows on a Mac without an emulator. It just won't work. A deeper question is why you feel the need to carry Windows with you at all times. Have you considered counseling, Jerry?

It's also very difficult to get true Dolby Digital 5.1 sound without a hardware decoder.

Dual-Proc Aviation

Just a quick note to let you know that there is at least one other game besides *Quake III* that is SMP capable. *Falcon 4.0* can also use two processors. One is used for the Campaign and the other is used for the simulator. I'm sure that there will be a lot of people who get Windows 2000 just for this reason alone!

—*John "Tex" Houston*

Decoding the Hard Way

I've noticed that in many of your system reviews, you state you would drop in a hardware DVD decoder. The lack thereof is cited as a minor "minus." I work as a computer technician/system builder for a low-volume OEM. I have seen DVD movies on more systems than I would care to count, running on both software decoding and on Hollywood Magic Plus hardware decoders. To be honest, I've never seen a difference on any system faster than a Celeron 400. The price of a software decoder is $20. The price of a good hardware decoder is $65. Off-loading the work to the CPU is a bad idea, but let's be realistic. How many people are trying to frag a buddy on *Quake III* while watching *The Matrix*? If you are doing something that CPU-intensive, then you really aren't paying attention to the movie anyway.

So why are you guys so adamant about having a hardware decoder in every speedy system that comes through the door?

—*James Ward*

Reviews editor Josh Norem replies: We prefer hardware decoding because PCI decoder cards feature TV-out connectors, and we prefer to watch movies on gigantic television monitors, for the full home-theater experience. Systems with software decoding rarely have any type of TV-out solution. It's also very difficult to get true Dolby Digital 5.1 sound without a hardware decoder, and six discrete audio channels makes a world of difference in action movies. However, if you don't plan to watch movies on your TV and don't care about 5.1 surround sound, then software decoding will suit your needs just fine.

CUT COPY PASTE

▶ In the April issue CD-RW review roundup, we misreported scores for the TDK veloCD and the HP CD-Writer. In the categories of mixed-mode CD duplication and data CD creation, the two drives' scores were swapped.

▶ In the May issue notebook feature, we incorrectly reported that *Thief: The Dark Project* uses the *Quake* engine. In fact, it uses its own proprietary "Dark Engine."

▶ In the May issue "VCR Videocards" review roundup, we incorrectly reported the *Quake III* score for the Marvel G400-TV. The frame rate that we reported was achieved while running Matrox's TurboGL drivers, which, unbeknownst to us, knocked down our standard test settings. The actual score using Matrox's full OpenGL ICD is 18.5fps—2.4 frames slower than the All-in-Wonder 128 Pro. The score change does not affect either card's verdict rating.

▶ *3DMark2000* is based on the Max Payne engine developed by Remedy Entertainment, not 3D Realms as we reported in May's Benchmarking White Paper. ✱

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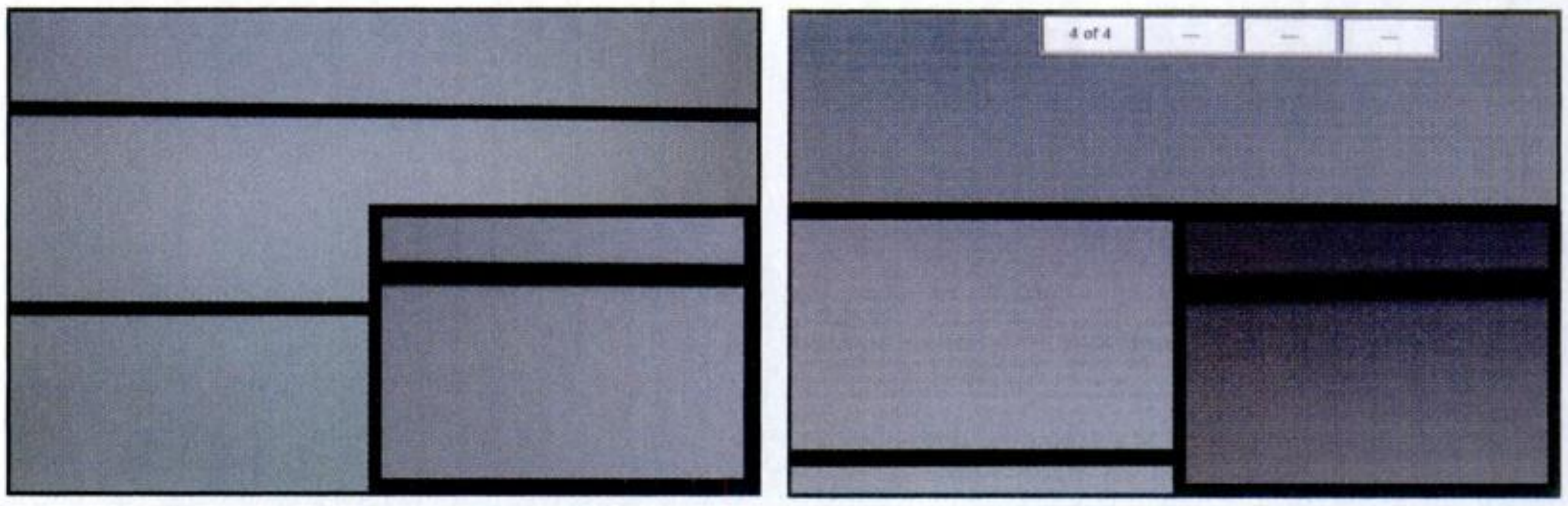
technology preview ▶ next-gen I/O

Intel Revamps PC Pipelines

Three new technologies promise faster connection speeds and higher quality data

If you think your brand new PC is next-gen, think again. Even if your box was built in 2000, many of its sub-systems could date back to the early 90s. Within the next two years, the PC as we know it will receive a much needed I/O infrastructure update. These changes promise to increase the image quality on monitors, improve hard drive performance and installation, and finally let you use digital USB speakers that won't cause a lock-up when you fire up *Photoshop.* Let's take a look-see, shall we?



These *DisplayMate* test screens reveal the video noise induced by an analog interface. The screen on the left was pulled from a pure digital LCD. The screen on the right was pulled from an LCD with an analog-to-digital converter.

Digital Visual Interface

Since the advent of the lowly IBM PC, machines have used essentially the same display technology: Digital data is converted on your videocard to analog data, which is then piped to your CRT. Traditionally, the fidelity loss resulting from the single digital-to-analog conversion hasn't been an issue. With the advent of flat-panel LCD displays, however, the number of conversions doubles. First, digital data is converted to analog in the videocard's DAC, and then it's sent to your flat-panel. Because LCDs are inherently digital, the analog signal must be converted back again to ones and zeros. This second conversion layer has generally led to poor display quality (i.e., video noise) and added expense (to pay for the extra conversion circuitry).

Now, Intel is pushing to standardize a new display interface, called Digital Visual Interface (DVI), that would eliminate the second conversion layer. With DVI, digital display data is sent without any conversion from your videocard directly to your flat-panel, without any loss in quality (theoretically). Side-by-side comparison testing has demonstrated that the results are amazing; the annoying shimmer effect found on almost all analog flat-panels is effectively precluded.

Flat-panels with digital interfaces are nothing new, but DVI could settle the connector wars that have made videocard compatibility a crapshoot. In short, DVI is expected to help consumers forever forget about DFP, OpenLDI, and PanelLink. Intel is involved because it has a stake in promoting any standards that promote computing. The company used a similar strategy when it helped push PCI over VL Bus, and when it stepped in to clear roadblocks for the V.90 modem standard.

Even on CRTs, a DVI interface promises to boost clarity. Because it's based on an old-school cathode ray tube, a DVI-ready monitor will still need an analog feed, but the DAC process will occur in the monitor rather than in the PC, which can be a hotbed of electrical interference that can degrade image quality. A digital CRT should also let manufacturers build monitors with tighter spec tolerances, because all digital signals should be the same. Traditionally, monitor vendors have had to compensate for poor and out-of-spec analog signals that vary from videocard to videocard.

The first monitors that boast DVI and analog support will be priced slightly higher than their analog-only versions. But in the long-run, DVI promises to

SPIN CYCLE

This month's top stories broken down ▶

HEADLINE	NEWS	DETAILS	THE SPIN	OUR TAKE
3D Consolidations	No fewer than four graphics companies recently traded owners.	First ATI purchased ArtX, then 3dfx bought GigaPixel. S3 sold its graphics division to VIA Technologies and 3Dlabs bought Intergraph's Intense3D.	With development costs high and profit margins low, analysts have predicted that the shakeout, which began last year, will continue for months.	In this Darwinian deathmatch, only the strongest survive.
Group Calls IE 5.5 Substandard	A group that promotes standards on the web blasted Microsoft for not following web standards in its upcoming *Internet Explorer 5.5* release.	The Web Standards Project, which purports to promote web standards, said the new browser makes it difficult for people without Windows and *IE5.5* to view some web pages.	"Why should anyone settle for web pages that work on only one browser, on one platform, and on a limited set of devices?" asked a spokesman for the Web Standards Project	Maybe *Internet Explorer* should be spun off into its own company when the government breaks up Microsoft.

make monitor production cheaper by eliminating the need for multi-synching.

The emergence of a pure digital interface also raises concerns about copyright protection, since pirates could conceivably use the interface to make perfect copies of copyrighted material from DVD and HDTV signals. To address this, Intel has proposed the High-Bandwidth Digital Content Protection encryption spec. Using hardware on both the videocard and the monitor, HDCP will encrypt data on the PC before sending it to the display device, where it will be decrypted. The rub is that only new DVI-equipment will have the feature, which creates a slight risk of obsolescence for those who invest in DVI early on.

Intel officials have downplayed that issue. They claim that any DVI monitor will be able to display protected content, because the HDCP-equipped DVI card will simply sense that an older DVI monitor lacks HDCP features and will lower the image quality to keep the content protected. Of course, no one has accounted for consumer acceptance. Will people embrace a standard that reduces image quality on their older equipment? Intel officials say the loss won't be enough to irk people.

HDCP is really for the day when PCs are expected to be used to output images to HDTV and other consumer electronic devices. It's even possible that first-run movies will someday be streamed directly to people's homes and displayed through a PC plugged into an HDTV. Without the ability to protect its content, Hollywood would likely fight changes in the way movies are distributed—hence HDCP.

One thing's for certain: The digital connection wars for flat-panels appear to be over. DVI-equipped videocards from ASUS, Leadtek, Elsa, and Matrox are already available. ViewSonic has begun offering CRTs with DVI. Stay tuned for reviews.

Technology	What it does	Pros	Cons
USB 2.0	Increases bandwidth on the USB port to 480MB/sec.	Scanners, Zip drives, and devices that need more bandwidth will get a shot in the arm from USB 2.0. USB 2.0 is backwards-compatible with USB 1.1 and 1.0.	480MB/sec is theoretical and detractors say it won't hold a candle to IEEE 1394, which it may compete with on devices such as scanners and printers.
SERIAL ATA	Ditches clumsy parallel ATA cabling for svelte low pin and low voltage cabling and UPS throughput to 1.6Gbps.	Cables won't be as restrictive to airflow and cooling as parallel ATA cables. Backward compatible with older ATA drives using adapters.	Limited only to four devices. Doh!
DVI	Eliminates needless DAC/ADC conversions in flat panel monitors and moves DAC process outside of the PC in normal CRTs.	Promises to offer crisper images while decreasing the cost of monitors.	Intel is pushing a content protection scheme for DVI that could hurt adoption by some consumers, and competing DFP spec isn't completely dead yet.

Serial ATA

There's nothing more infuriating than trying to get a stiff Parallel ATA ribbon cable to loop from your hard drive to your DVD-ROM drive. Twist, pull, and snap—you've just broken a pin on your new 12x DVD-ROM drive.

Of all the new I/O technologies proposed for the PC, Serial ATA—the evolutionary replacement for Parallel ATA—is the most overdue. Serial ATA promises to be significantly faster, with initial speeds at 205MB/sec and an expected speed of 768MB/sec by the time its life is over in 10 years.

Besides surpassing the upcoming ATA/100 and ATA/133 speeds, Serial ATA's biggest plus will be its adoption of a low-pin-count, low-voltage connector. Parallel ATA

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to the pertinent details.

HEADLINE	NEWS	DETAILS	THE SPIN	OUR TAKE
Intel Adds Coppermine Celerons	Intel has released a slew of Celerons based on the 0.18 Coppermine process.	Ranging in speed from 466MHz to 600MHz, the Celerons include support for SSE as well as 128KB of full-speed L2 cache, all for under $200 (in lots of 1,000).	"Intel is keeping its foot on the gas in the value PC market segment," said Intel's Pat Gelsinger.	This Coppermine-lite may not do the job if AMD's cheapo CPU, the Spitfire, is as fast as it's expected to be.
VIA Does DP	Before the year is out, VIA Technologies will offer an alternative for dual processor lovers.	VIA says it will offer the popular Apollo Pro 133A with support for dual Pentium III processors, along with AGP 4x, PC133, and ATA/66 support.	"With dual processor support on the VIA Apollo Pro133A, VIA is expanding the range of systems that can be built around VIA chipset solutions and creating cost-efficient alternatives for the industry," said VIA's Ted Lee.	Though the AP133A trails Intel's 820 in performance, at least you don't have to mortgage your home to fill up the memory banks.

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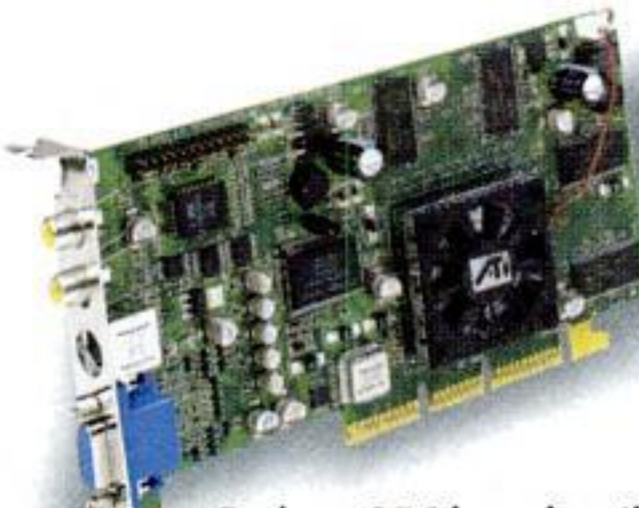
technology preview ▶ videocards

Radeon vs. GeForce 2

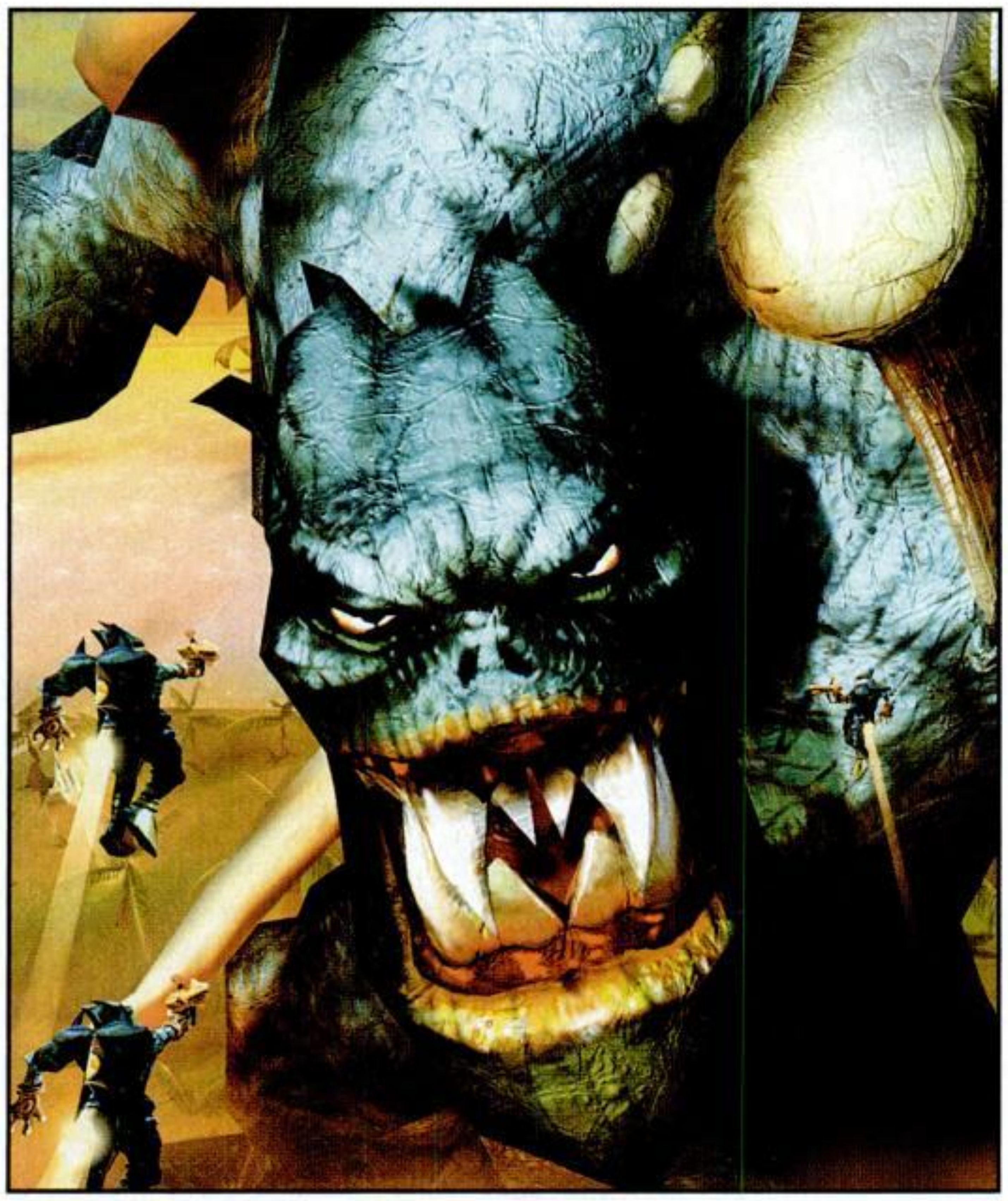
ATI Challenges nVidia for the videocard title

The heavyweights of the videocard world are preparing for a showdown. Settling the scales at 30 million transistors is the challenger, ATI's Radeon 256—a surprisingly capable 3D chip from a company known more for its welterweight products. In the opposite corner, weighing in at a hard and mean 25 million transistors, stands nVidia's GeForce 2 GTS, the impressive successor to the current 3D champ, the GeForce. ATI and nVidia have prepared their pixel-pumping pugilists by dropping down to a 0.18-micron manufacturing process, which allows a faster core clock, a smaller die size, and less power consumption. The new process also lets the two companies pack their graphics processors with enough innovation to change the way you look at your 3D graphics. Needless to say, these chips are ready to rumble.



Radeon **256 boards will appear in late July, after ATI finds the appropriate memory speeds to match with its chip.**

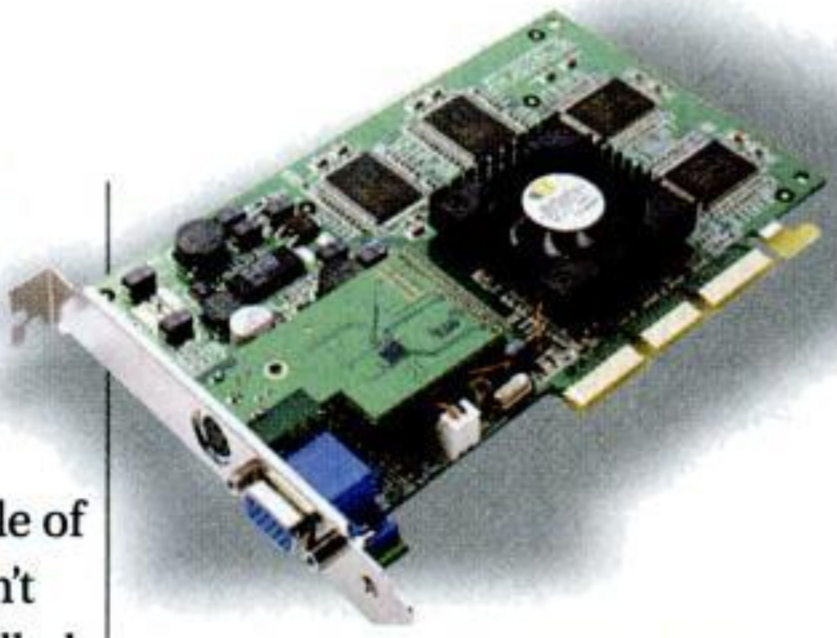
Each running at 200MHz and boasting gigatexel fill rates, the Radeon and GeForce 2 have much in common. Both sport second-generation geometry engines that handle the clipping stage of the 3D pipeline, as well as transform and lighting. Clipping removes the objects that lie above, below, to the right, and to the left of the viewable scene, before the objects are rendered. This saves the rendering engine the trouble of processing objects that won't be seen. With clipping handled by the graphics processor—rather than the CPU, as was previously the case—triangles no longer need to be cycled back and forth through the CPU as they're fed through the 3D pipeline. Both the Radeon and the GeForce 2 support six programmable clip planes.



Incredible texture details are available through pixel shader technology.

Both chips also have the same taste in memory. Sure, you can feed them regular old SDR memory, but to get the most from these monsters, they need a diet rich in DDR memory—the more, the better. They may be a heck of a lot faster than the previous generation of 3D chips, but the Radeon and the GeForce 2 still use a 128-bit bus to interface with onboard memory. With the gigatexel fill rates that these chips push, the memory bus gets saturated pretty quickly (a problem that limits the four-pipeline GeForce 2 more than the two-pipeline Radeon). Using DDR memory doubles the effective transfer speed of the bus without requiring the memory clock to run faster.

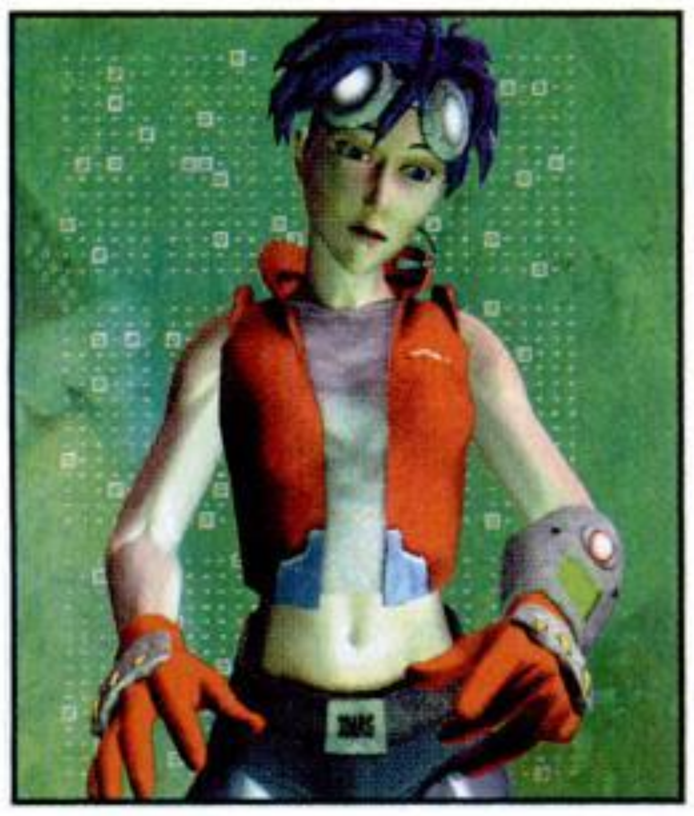
But the similarities end when you take a peek inside these chips. Where the GeForce 2 sports four 64-bit pixel pipelines with two texture units each, the Radeon 256 equips itself with two 128-bit pipelines housing three texture units each. While it's easy to just add up the texture units and declare a winner, each configuration has distinct advantages.



Boards based on nVidia's GeForce 2 will initially appear with 32MB DDR, but 64MB boards will soon follow.

For brute-force rendering, you can't beat GeForce 2's four-pixel pipeline, and the two texture units in each mean it does multitexturing for free. The result should be blazing-fast frame rates in multitexturing gorefests such as *Unreal Tournament*. However, ATI is banking on memory bandwidth limitations to make the GeForce 2's extra pipelines less effective when rendering complex 32-bit textures. This is where ATI hopes to put nVidia on the ropes. Three texture units allow the Radeon to rip through heavily textured games such as *Halo*, since it doesn't have to do the multiple textures in several passes.

nVidia is touting the GeForce 2 as a gigatexel shader (GTS), and with the number of texture units the chip is packing, it's easy to see why. According to Microsoft, programmable pixel shaders are the next big thing. Pixel shading refers to the ability to define a mathematical format for the way pixels are painted. Currently, textures are handled using lookup tables. Under a programmable rendering architecture such as DirectX 8.0, complex texture and shading effects will be described mathematically using pixel shaders. The immediate benefit comes



The Radeon 256 provides a feature-rich environment for highly detailed character models.

from generating texture patterns, such as wood grains, by using mathematical descriptions and noise patterns. Of course, it won't be until sometime late next year that games actually use pixel shaders, but the same could be said of the vertex skinning and vertex tweening modeling features in ATI's new chip (previewed in the April issue).

The current trick up ATI's sleeve is HyperZ technology. HyperZ combines lossless data compression with aggressive on-chip caching techniques, yielding a performance improvement—in every game—of about 20 percent. With HyperZ, the amount of data that needs to be pushed and pulled from the frame buffer decreases dramatically, alleviating memory bandwidth performance constraints.

ATI claims that HyperZ technology works without reducing z-buffer accuracy, which would cause polygon errors and incorrect rendering depths. It will be implemented through a driver toggle switch, similar to 3dfx's full scene anti-aliasing (FSAA)—just turn it on and HyperZ works its magic.

With the GeForce 2 arriving a month before the Radeon, ATI will definitely have a battle on its hands. nVidia has repeatedly demonstrated that every six months it can ship a high-performance part that will blow the doors off everything else. Hopefully, ATI can begin doing the same.

—SeanDowney

	GeForce 2 GTS	**Radeon 256**
Core Clock Speed	200 MHz	200MHz
Memory Clock Speed	166MHz (333MHz with DDR)	166-183MHz (333-366MHz with DDR)
Memory Bandwidth	5.2GB/sec	5.2-5.7GB/sec
RAMDAC	350MHz	350MHz
Fill Rate (pixels)	800	400
Fill Rate (texels)	1600	1200
Triangle Rate (strips)	30Mtris/sec	30Mtris/sec
AGP/PCI	AGP 4x (fast writes) PCI	AGP 4x
Available	June	July

Cont. from pg 19

requires an unwieldy 52-pin cable, plus power and ground lines. And to hit the higher speeds of ATA/66 and ATA/100, an expensive 80-pin wire with better grounding is required. These ribbon cables everyone loves to hate are also a big impediment to airflow in a PC.

Serial ATA will drop the number of pins to fewer than half a dozen, and will cut voltage in half. Recognizing the need for a relaxed transition to the new spec, people with older motherboards and Parallel ATA will be able to use new Serial ATA drives with help from an adapter. Likewise, people with newer Serial ATA controllers will be able to use older drives through an adapter.

Like Parallel ATA, Serial ATA will only allow you to use four drives at once (unless you add a stand-alone Serial ATA controller card). Intel says that the need for more than four drives is rapidly fading away, but you might disagree if you're already feeling the squeeze with two hard drives, a DVD-ROM drive, and a CD-RW. Luckily, by the time Serial ATA is introduced next year, hard drive capacities will exceed 100GB, and combo DVD/CD-RW drives will have come down in price. For those who need more mass storage, USB 2.0 and FireWire devices will take up the slack.

Serial ATA is expected to hit in the second half of 2001. By that time, ATA/100 and ATA/133 will have already been introduced, so plan your upgrades carefully.

USB 2.0

USB is great for hooking up your scanner, printer, CD-RW, mouse, keyboard, modem, NIC, digital speakers, and web cam. Just don't try to use everything at the same time or your system will grind to a halt. That's been the major complaint with USB 1.1; with just 12.5Mb/sec of shared bandwidth, the spec can't handle the amount of chores it's increasingly being asked to do.

Enter USB 2.0, which shoots bandwidth up to 480Mb/sec (that's about 60 megabytes per second)—enough to handle the needs of high-resolution scanners, high-bandwidth web cams, and most IDE hard drives. USB 2.0 proponents say the spec will have enough bandwidth to run a full MPEG2 stream from your web cam alongside a scanner, printer, and external storage, all without choking. In fact, Intel execs predict USB 2.0 will replace SCSI for such low-end I/O chores as tape drives and CD-ROMs.

USB 2.0 will be both backward and forward compatible with USB 1.1 devices. Down the road, you'll be able to plug your USB 1.1 devices into a USB 1.1 hub, which will be plugged into a USB 2.0 hub. This year, USB 2.0 will likely be supported through PCI expansion cards, and within a year or so, new motherboard chipsets should incorporate it.

So why USB 2.0 when an existing high-speed serial interface exists in IEEE 1394? The 1394 "FireWire" spec has become the ubiquitous interface to move video from a DV cam to a computer. FireWire already offers about 400Mb/sec of usable bandwidth and a "1394.b" variant offers 800Mb/sec.

The key conflict may be politics and control. USB 2.0 is host-centric in that it relies on the PC's CPU to communicate. FireWire allows devices to operate in a peer-to-peer configuration independent of any CPU. Intel backs USB 2.0, while Apple and consumer electronic companies such as Sony back FireWire. Of course, it's not as simple as Intel simply backing a standard that leans on CPUs; Apple has made FireWire less palatable to manufacturers by charging a small licensing fee for its use.

Though it might appear that the specs are heading for a showdown, it's likely both will coexist. USB 2.0 will likely connect printers and scanners, while 1394 will connect A/V equipment. ◆

—Gordon Mah Ung

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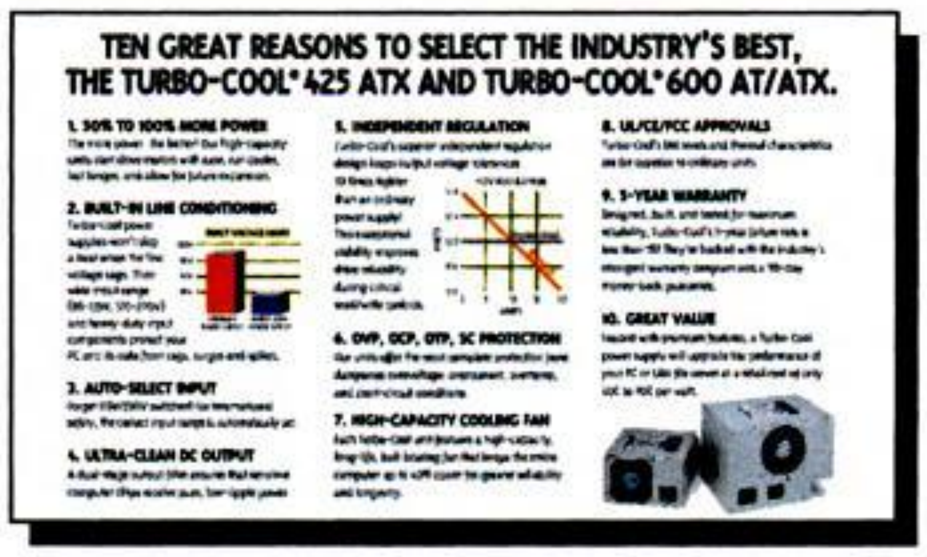

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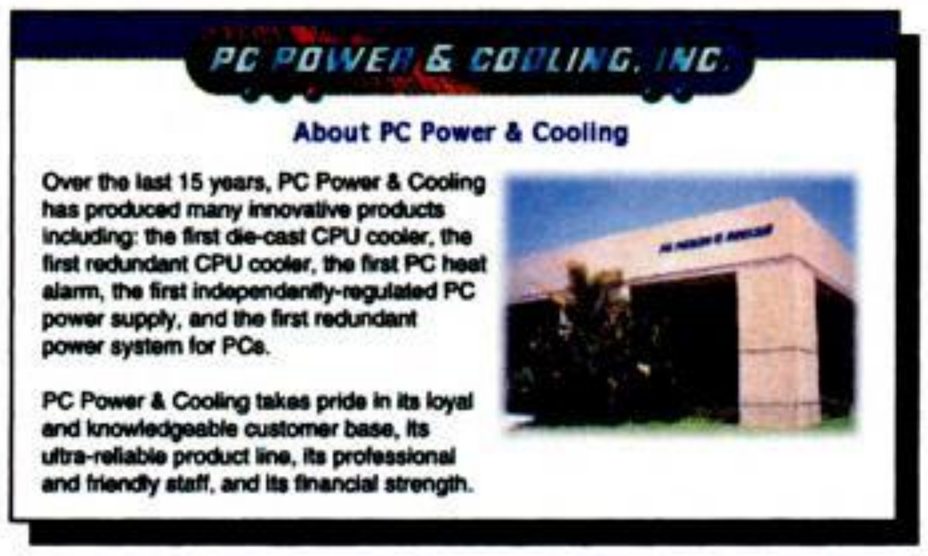
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▶Maximum PC takes a bite out of bad service and gear

WATCHDOG

Got a bone to pick with a vendor? Been spiked by a fly-by-night operation? Sic The Dog on them by writing **Watchdog @maximumpc.com**. The Dog promises to get to as many letters as possible, but only has four paws to work with.

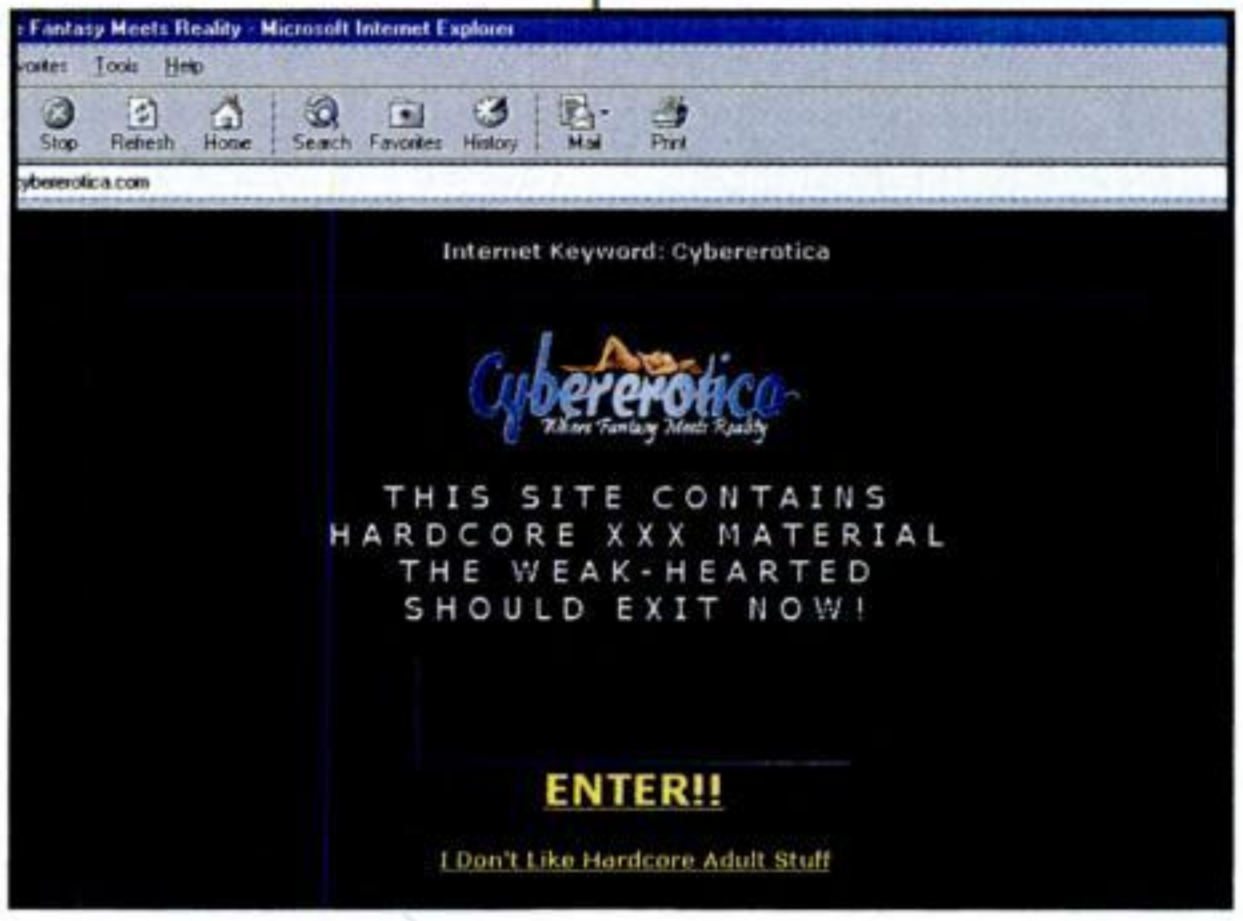
GETTING PORN SAFELY

DEAR DOG: I have kind of an embarrassing problem, but I don't know who else to turn to. One night last month, some friends and I came back to my house (pretty wasted) and decided that the best thing to do was to look at some porno. After looking at lots of crappy pics, we stumbled across Cybererotica. It is a pay site but it has a "free seven-day trial offer." We decided to use my credit card. After reading the Terms and Conditions, I thought it would be safe.

It turned out to be an okay site, but since I didn't want to pay $34.95 a month ($51.22 here in Canada), I cancelled my membership the next day. At that time, a page came up confirming the cancellation.

Today, I received my VISA bill. To my surprise, it shows a charge for $51.22. I looked all over Cybererotica's site for an address to contact, but came up emptyhanded. I hope you can help.

—Jon Cooper



Internet Keyword: Cybererotica

Cybererotica
Where Fantasy Meets Reality

THIS SITE CONTAINS
HARDCORE XXX MATERIAL
THE WEAK-HEARTED
SHOULD EXIT NOW!

ENTER!!

I Don't Like Hardcore Adult Stuff

Before becoming a member of an adult web site, read the fine print—don't just look at the pictures.

THE DOG RESPONDS: THE DOG contacted Ron Levy, owner of Voice Media (a.k.a. Cybererotica), about the problem. Levy said that if the account was cancelled within the trial period, the system should have automatically processed it. However, if the charge fell on a billing cycle, it's possible the system automatically charged the card. Levy said he was surprised Cooper couldn't find the number to cancel, as it's on the cancellation form, and that the 800 number should have been on the customer's credit card bill. To validate Levy's claims, The Dog sniffed through Cybererotica's web site. There is indeed an 800 number and an address for the company, and an easy-to-access (if lengthy) cancellation form.

"We're not hiding," Levy tells The Dog. "We make ourselves very accessible. We want to hear from people, because we don't want them to call their bank and do a charge back."

Levy says Cybererotica has 140 people in customer service working 24 hours a day. Skeptical of the claim, The Dog tested this by dialing the service number late at night. After a four-minute wait, a customer service rep answered our call to cancel The Dog's "membership." Yow. If computer companies offered 24-hour support that answered within five minutes, the world would be a happier place.

Then again, Levy certainly seems to know something about the online porn industry. Forbes magazine estimated that Voice Media raked in some $55 million last year. Cybererotica is a legitimate business.

The Dog understands the need to use proper protection when searching for porn. Here are a few tips you should follow:

1. Read and print the "terms and conditions" agreement of the porn site you're planning to join. Also jot down the date and time that you joined. If the site offers no phone number, street address, or e-mail address for contacting the company, stay away.

2. Don't lose your account and password, because you'll need those if you cancel your membership. Also be sure to keep track of the URL of the site you're signing up with—it's easy to lose.

3. If you decide to cancel, contact the company either through its web site or by phone. Almost all would rather return your money than deal with the hassle of a charge back, as this endangers their merchant accounts.

4. Document all your correspondence with the company, from beginning to end.

5. If the site does not respond to your e-mail, send a registered letter requesting a cancellation. To find out the physical address of a domain, visit www.geektools.com and click on the Whois button.

6. If there's no response, contact your bank and request a charge back. You can also write the bank and include copies of your correspondence. If you're afraid that your bank will think you're a perv for visiting porn sites, consider that hundreds of millions are spent on porn every year—you're not alone, so get over it.

7. In general, recurring charges cannot be blocked by your bank. If you continue getting charges from a site or store, the only solution may be to cancel the card and

"Some friends and I came back to my house (pretty wasted) and decided that the best thing to do was to look at some porno."

switch banks.

8. The Federal Trade Commission likes to hear from you. There may not be any immediate reaction but, like the police, they won't know something's wrong if no one tells them. Visit www.ftc.gov/ftc/complaint.htm.

For more tips on safe sex surfing, visit the consumer section of www.janesguide.com and www.pornofaq.com. Here's one final tip from The Dog: If you find yourself on a porn web site and want to exit without those popup windows, simply click on the "do not enter" button. Woof.

GOOD BUY.COM

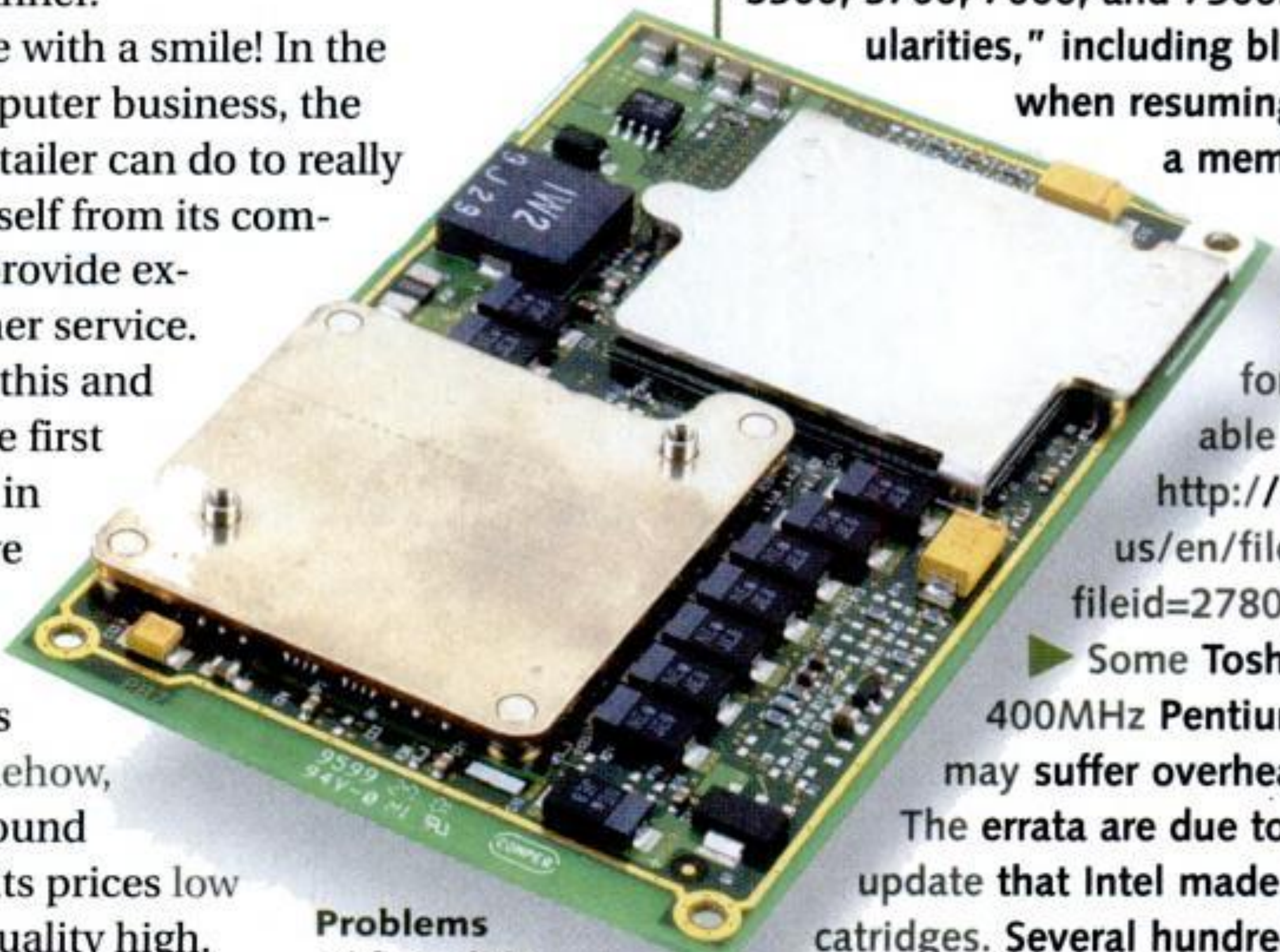
DEAR DOG: I thought that with all the complaints against various Internet retailers, a compliment for one that does an excellent job is overdue. I made some purchases from Buy.com and the experience can only be described as positive. I recently purchased an Epson scanner that had some problems. I sent an e-mail to Buy.com's customer service department, received an answer and RMA number, and was told I would be sent a call tag to return the scanner at Buy.com's expense—all in less than 15 minutes.

My next e-mail to Buy.com was answered in five minutes. I later contacted the company by phone and my hold time was about one minute. I received an e-mail from Buy.com two days later, stating that a new scanner had been shipped to me on the day I made the initial call. It arrived before the call tag that I used to ship back the defective scanner.

This is service with a smile! In the cutthroat computer business, the only thing a retailer can do to really differentiate itself from its competition is to provide excellent customer service. Buy.com does this and then some. The first thing to suffer in the competitive world of low-balled retail computer sales is service. Somehow, Buy.com has found a way to keep its prices low and customer service quality high. That's a hard nut to crack. Other retailers must aspire to do the same.

—Nat Broiman

"Somehow, Buy.com has found a way to keep its prices low and customer service quality high."



Problems with mobile modules like this may cause certain Toshiba notebooks to overheat and die.

Got an opinion on this article?
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BAD BUY.COM

DEAR DOG: I recently went through credit card hell with Buy.com. I purchased an item for $1,044.71. A few weeks later, I checked my card's balance and found that Buy.com had dinged me for an additional $841. After waiting on hold for half an hour with Buy.com, I was told the company didn't place the charge. I asked them to fix it, and the representative said he couldn't. I was forced to wait another 30 minutes on hold while he looked for someone who could. The person who finally got on the phone said she couldn't fix the problem either, and referred me to her supervisor. He said the charge was "stuck" in the system and would go away within 24 hours.

I called my bank the next day to check on the charge, and found that the account had been hit with another charge from Buy.com. My bank rep said she would take care of the problem, but that it could take a few days unless I could get Buy.com to fax a letter stating that they did not make the charges.

I called Buy.com and waited on hold for another 30 minutes. Then I spoke with a representative who told me that Buy.com wasn't responsible for either of the extra charges. I asked him to fax a letter to my bank explaining that. He said he'd forward my request to the accounting department, but couldn't guarantee when they'd get to it.

Argh! Caveat Emptor: Do not purchase anything from Buy.com!

—Luke G. Newport

NOTEBOOKS GLITCH ROUNDUP

▶ Between 200,000 and 400,000 Dell Inspiron and Latitude notebooks may corrupt data or crash, due to a memory problem. The notebooks affected were manufactured between February 1, 1999 and November 30, 1999. Models include: Latitude CPiA, CPiR, CPt, CPx, and CS; and Inspiron 3500, 3700, 7000, and 7500. The problem can cause "irregularities," including blue screens and system hangs when resuming from suspend mode or during a memory refresh. Apparently, the memory module is at fault. Dell is offering to replace the modules on affected notebooks for free. A diagnostic app is available for download from http://support.dell.com/us/en/filelib/download/index.asp?fileid=2780.

▶ Some Toshiba Satellite 4100s using 400MHz Pentium II and Celeron mobile chips may suffer overheating problems. The errata are due to an unannounced module update that Intel made last December to the mobile catridges. Several hundred Satellites have reportedly died from the problem. Toshiba and Intel say they have taken steps to contact customers who own the notebooks but, obviously, they can't reach everyone. If you have a Satellite 4100 with a 400MHz P-II, or a Celeron manufactured after December 1999, check the serial number. If it begins with Z9, 10, or 20, contact Toshiba at 800.457.7777.

▶ Finally, proving that Apple's mousetraps may suffer from as many problems as Microsoft's, iBook and PowerBook owners are being offered a patch to correct a bug that could cause loss of data. When people with iBook and PowerBook notebooks with IEEE 1394 (FireWire) try to restore the machines from sleep mode, there's a small chance the computer might not wake up. Visit http://til.info.apple.com/techinfo.nsf/artnum/n25130 for the patch. ✸

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known as a D.O.S. (Denial Of Service) assault. Hackers can turn home computers into cyberslaves, by secretly planting instructions inside these machines without the owner's knowledge.

In Washington, the Justice Department announced it would start an immediate investigation into the attacks. Attorney General Janet Reno promised a intensive search would begin for those responsible for causing the massive Internet blockage. However, she freely acknowledged that law enforcement officials had no concrete leads and the hackers had done an thorough job of covering their electronic footprints.

Officials have no idea whether this attack is the work of one, delinquent teenager or the coordinated effort of a band of cyber-terrorists, trying to cause some sort of economic calamity. In recent months, many government ites have been broken into, although no vital data has fficials say. How

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Kevin Mitnick, rece
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Basically, most **home computers** with high-speed
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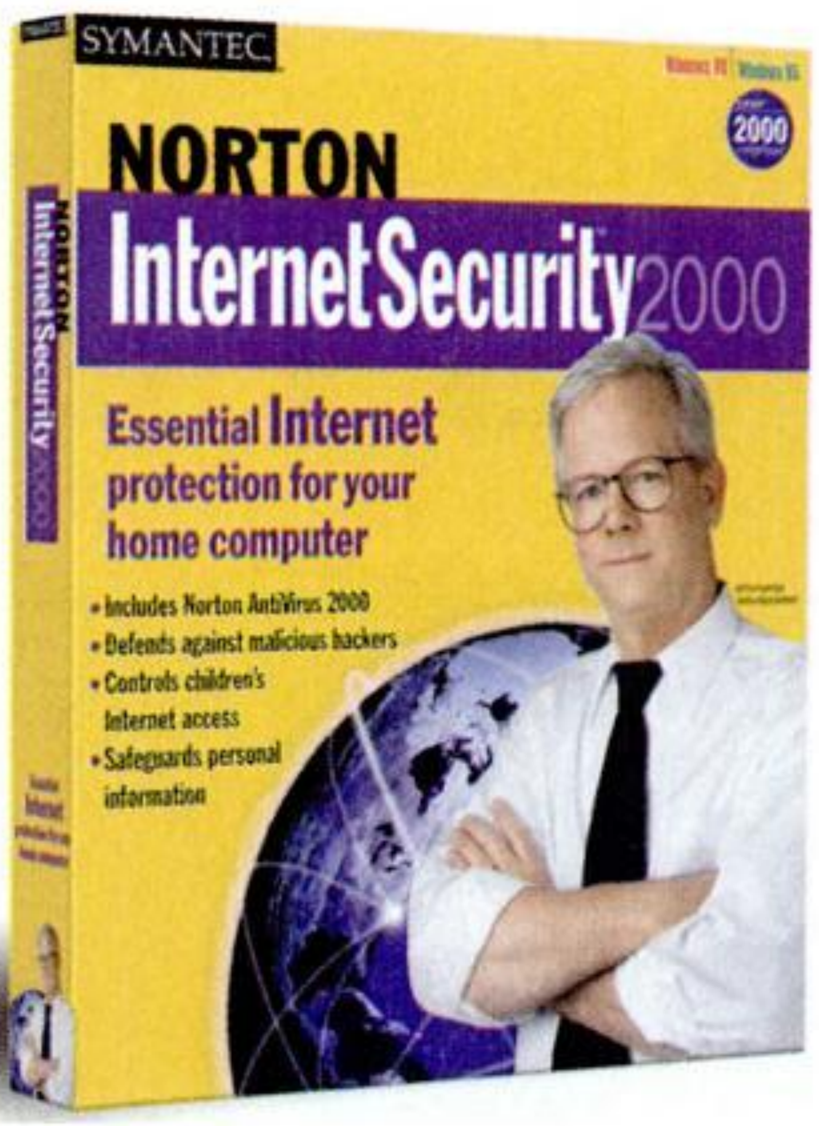
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WINLIST
March 2000

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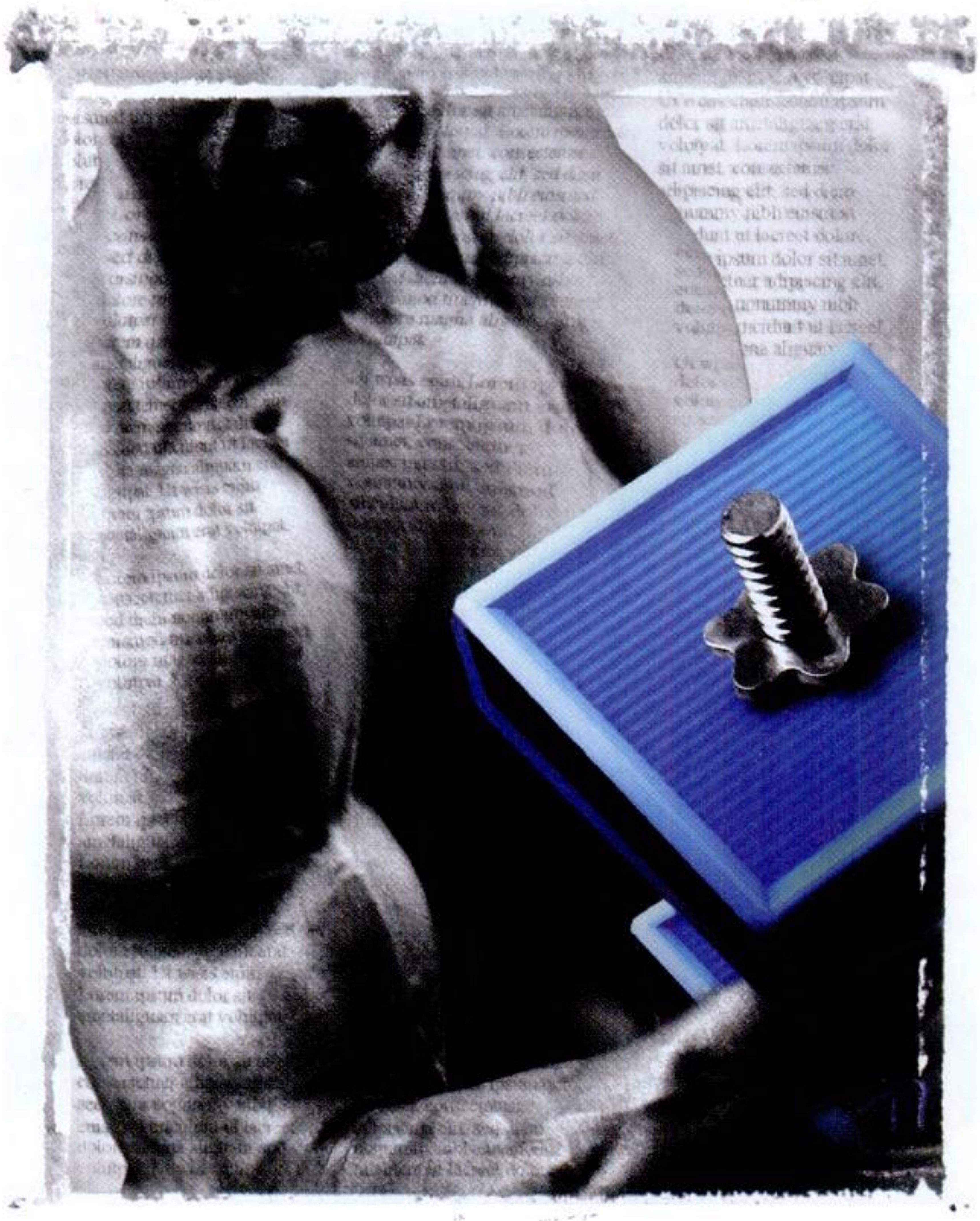

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Remember the Chevrolet El Camino? It was a car... *and* a truck. Casio's Wrist Audio Player (**www.casio.com**) updates and, in our opinion, improves upon the concept: It's a full-featured digital watch... *and* a portable MP3 player with 16MB of storage space. Along with all the accoutrements of a basic digital watch—alarm, date and time, stopwatch—the Wrist Audio Player can hold about 15 minutes worth of CD-quality MP3 files. Just snap the watch into the USB-equipped docking port that's attached to your PC, fire up the easy-to-use software, and snap the removable headphone jack onto the watch. The Wrist Audio Player is larger (but not heavier) than the average watch—much like the El Camino was larger than the average car—but its excellent sound output and raw gadget appeal make it worth the extra baggage.

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877.751.7467

ID#0602

CYE Robot

There's nothing even remotely human-like about the Cye robot (**www.personalrobots.com**), but still, it's darn cute. Maybe it's the fact that you can attach a small vacuum cleaner to it and send it off to suck up the spilt cat litter in your bathroom. Or that you can attach a cart to it and have it fetch libations from an appointed bartender in the kitchen. Cye communicates with your computer via a mini radio antenna, and the *Map-n-Zap* software helps you teach Cye the layout of its living area. The robot's home base must be a minimum of 3 square feet, carpeted, and near a corner that's close enough to the computer for the radio antenna to work; but overall, setting Cye up is easy. The latest version is sound activated, so by just clapping your hands, you can send Cye to do your bidding.

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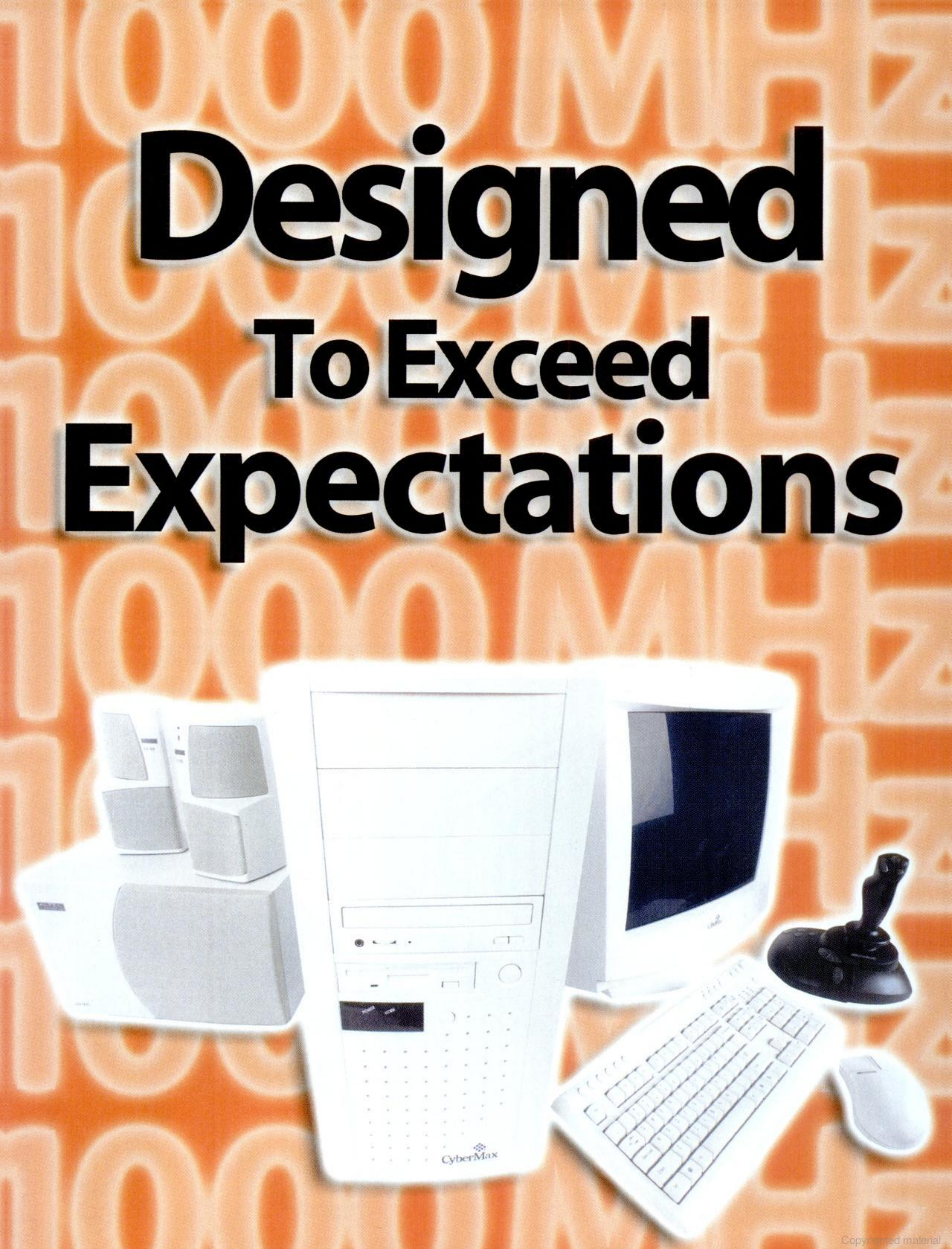
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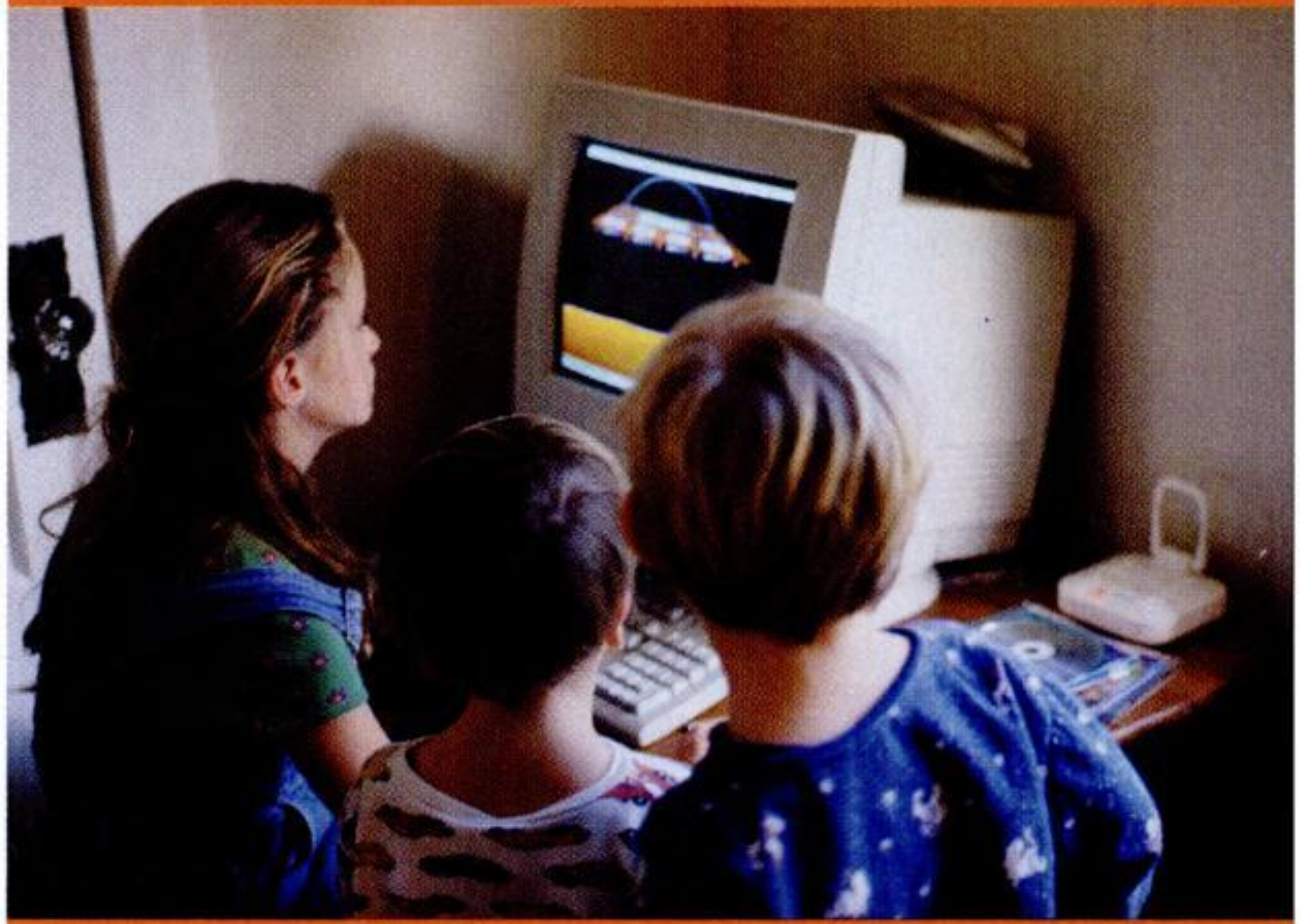

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▶TOMORROW'S TECHNOLOGIES EXPLAINED

FAST FORWARD

How to Beat the Heat

TODAY'S KICK-ASS PCS ARE RISKING MELTDOWN

Some people say you'll burn in hell for leering at online porn and playing violent computer games. We'll have to wait and see about that. But even if you don't worry about saving your soul, here's something to really get alarmed about: Your computer might be burning in hell right now.

The dark side of the megahertz derby is that today's PCs are running hotter than ever before. AMD's Athlon, widely celebrated as the first PC processor to hit 1GHz, burns about 65 watts. That's more than twice as much power as a 1GHz Intel Pentium III, and it's probably hotter than the light bulb in your desk lamp. Have you touched a glowing light bulb lately?

CPUs aren't the only things cooking. The latest 3D graphics cards are burning double-digit watts, too, thanks to their powerful graphics coprocessors and megabytes of video memory. The latest hard drives spin at 7200rpm, twice as fast as older drives, and they dissipate noticeably more heat. So do faster CD-ROM drives and removable hard drives—and to make matters worse, modern PCs tend to have more storage devices packed into their drive bays. Other system components, such as memory chips, aren't as power-hungry as CPUs, graphics cards, and disk drives, but they still contribute to a growing problem.

If your PC crashes mysteriously, especially on summer days, or after running for a few hours, overheating might be the cause. Sometimes it's difficult to isolate the problem, because applications and operating systems such as Windows tend to "leak memory" (consume system resources) over time, which often leads to a crash. Rebooting the machine always restores the lost system resources, so if your PC continues to crash after a restart, it's reasonable to suspect a cooling problem.

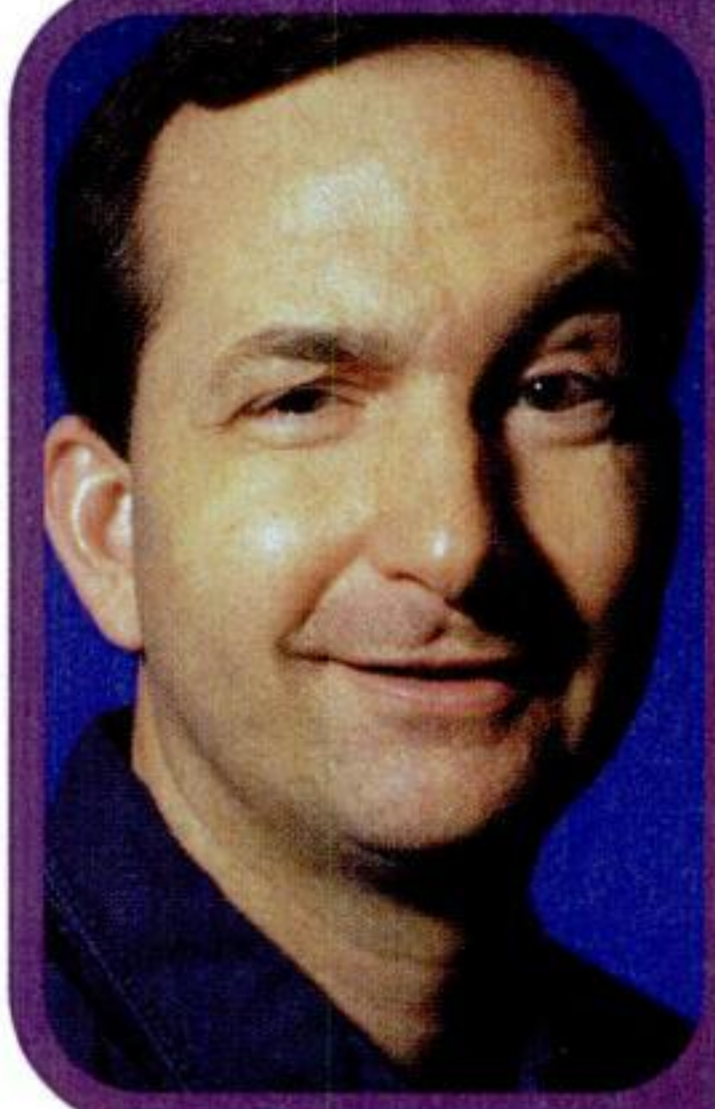
Some motherboards have temperature sensors, and some have a BIOS that displays a warning or shuts down the system if things get too hot. Usually, you can find a temperature readout by poking around inside the BIOS, but don't take it too literally—the sensors may not be accurate. I've tested my system with a darkroom thermometer that's accurate to within one-fourth of a degree Fahrenheit. This thermometer has a long probe that slides into the computer's case through an opening. (To avoid short-circuiting an electrical connection, I sheath the metal probe with a plastic straw.) If the temperature near the motherboard is much higher than 104 degrees Fahrenheit (40 degrees Centigrade), the PC has a fever.

If the temperature near the motherboard is much higher than 104 degrees Fahrenheit (40 degrees Centigrade), the PC has a fever.

Factory-configured, name-brand PCs rarely get sick this way. All the major PC vendors employ mechanical engineers who design the system for proper airflow. The trouble starts after you pack the drive bays with additional storage devices or fill the expansion slots with add-on cards. If you have a custom-built or homebrew PC, you're in danger from day one, because nobody has analyzed your system's airflow. And if you overclock your CPU, you're really flirting with the devil, because you're making a hot CPU even hotter.

Airflow analysis isn't as simple as it seems. For instance, I've seen hardware hackers run their monster machines with open cases, just as hot-rodders in earlier days used to remove the hoods of their cars to show off their monster engines. Although it contradicts common sense, an open PC may actually run hotter than a sealed PC. In a properly engineered system, the exhaust fans pull cool air over the heatsinks from vents on the opposite side of the case. If you leave the case open, the fans can't draw as much air over the heatsinks. Think about it: Have you ever heard of a wind tunnel with screen doors? Removing the port covers from behind empty expansion slots could cause the same problem. It might allow more hot air to escape, but it might also divert airflow from the all-important heatsinks. Only careful analysis can tell for sure.

If you suspect a cooling problem, the best solution is to equip your PC with as many fans as possible, keep the vents unobstructed, and rearrange the interior to leave empty expansion slots or bays near the hottest devices. One more suggestion: On balmy summer days, you might consider playing outside instead of staying indoors with your computer. ◆



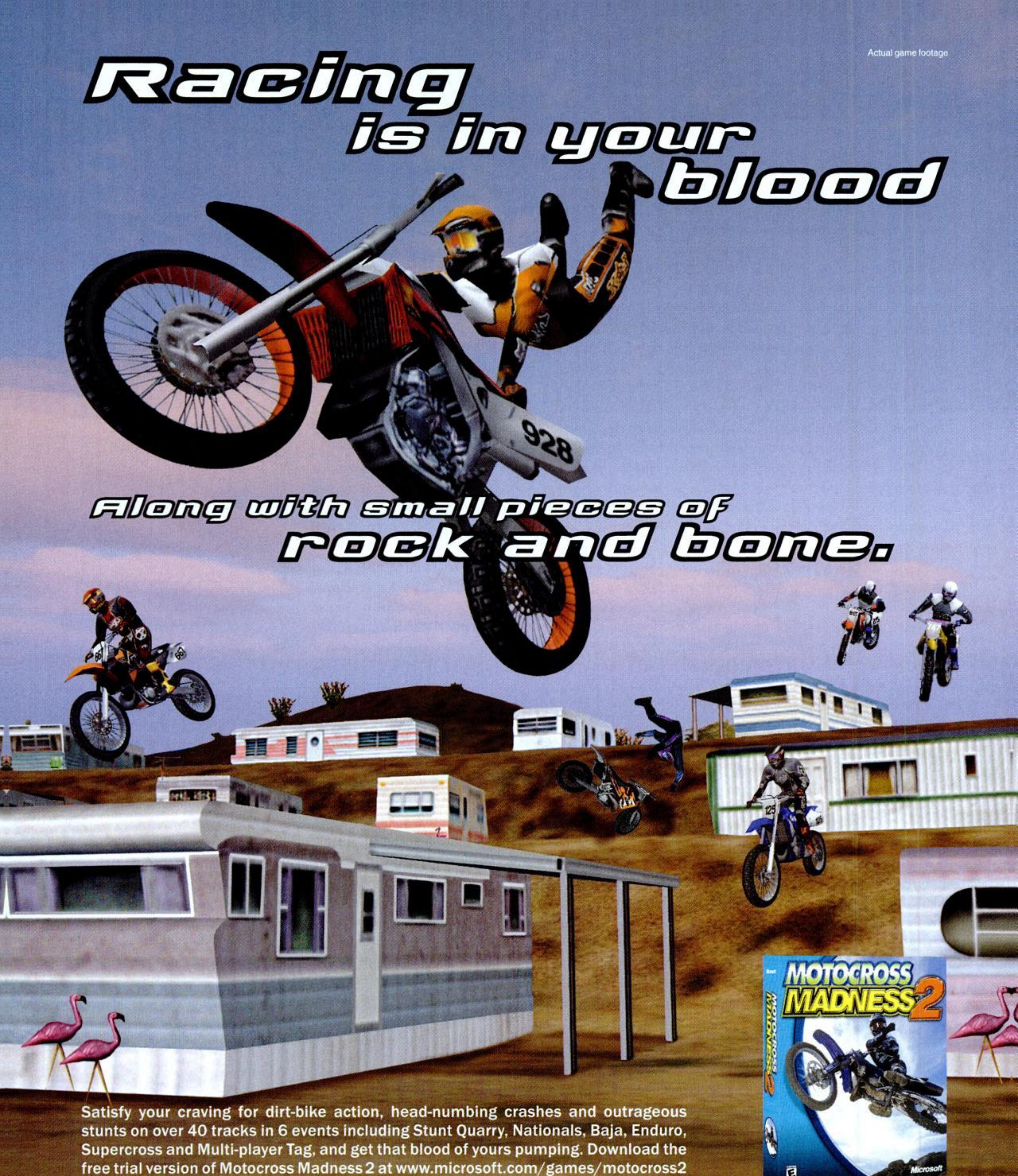
TOM HALFHILL was senior editor at ***Byte*** magazine and is regarded as one of the most knowledgeable experts on processor technology in the industry. Contact him at **thalfhill@maximumpc.com.**

Random Thoughts

▶ True story: More WebTV users complained about system failures after the latest WebTVs came with internal cooling fans. An investigation revealed that some people didn't realize that the humming noise came from the fans. To suppress the noise, they wrapped their WebTVs in old towels or sweaters.

▶ Inprise, formerly known as Borland and now owned by Corel, is porting all of its rapid application-development tools (*C++ Builder*, *JBuilder*, and *Delphi*) to Linux. That'll make it much easier to write Linux software in C++, Java, and Object Pascal—and more Windows software will be ported to Linux, too.

▶ Microsoft probably picked Pentium III over Athlon for its X-Box videogame console because the Intel chip burns less power and has better 3D-graphics extensions (SSE). Tough break for AMD.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▶THE SCOOP FROM A MAJOR PLAYER

GAME THEORY

PCs: The Console-ation Prize?

HOW A STRIPPED-DOWN X-BOX CHEATS DIE-HARD PC GAMERS

PC game freaks can be excused for worrying about the future of their hobby. As we stand in the midst of a console maelstrom, things don't look particularly bright. When companies are closing doors, sales are dipping, and a patron saint of PCs such as Microsoft is getting into set-top gaming, you have to really wonder where PC games are going.

Before we really knew what the X-Box was, it seemed like a good thing. The preliminary specs, and the MS moniker, made it sound like a dedicated ultra-PC for the TV, a level of convergence between the desktop and the set-top. Imagine having at your disposal a 600MHz Intel chip, a 300MHz custom nVidia graphics chip, 64MB of dedicated memory, and 64-channel positional audio, and using it all to play the finest PC games on a 35-inch high-definition TV. With complete DVD playback capability and AC-3 support, it sounds like a dream machine.

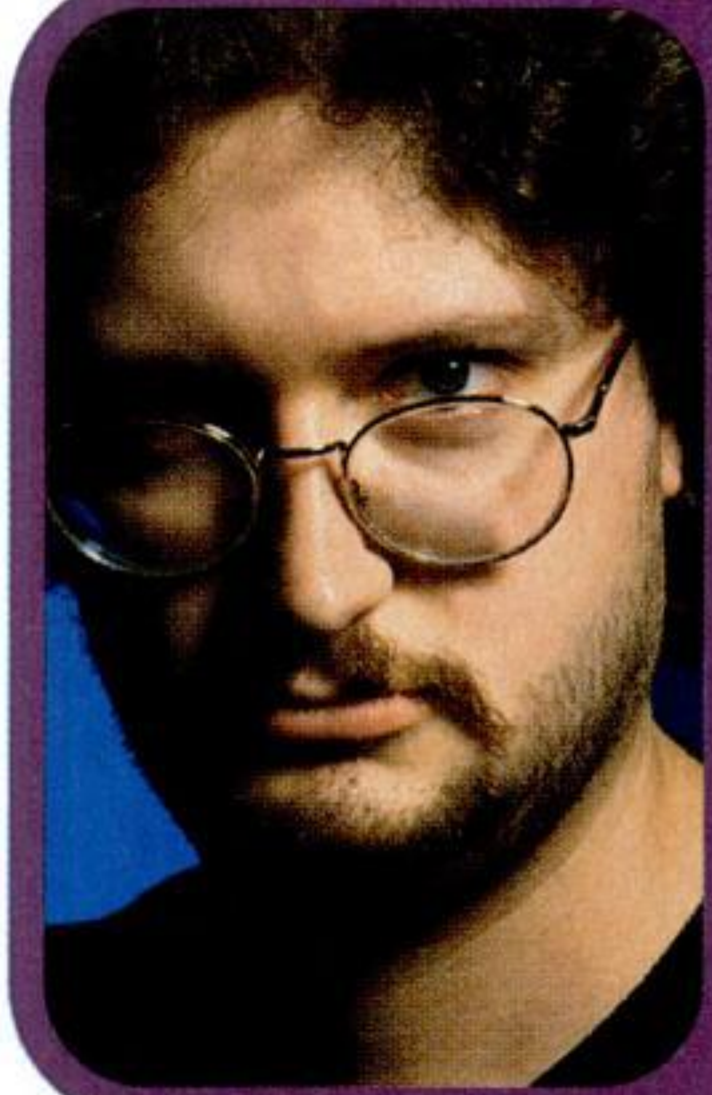
Almost all those specs do indeed fit the X-Box, along with support for resolutions up to 1920x1080 and triangle rates that approach 300 million polys per second, built-in Ethernet support, and anti-aliased pixel fill rates of 4.8GB/sec. But the machine won't be a set-top PC. You can't connect it to your PC, you can't play PC games on it, it won't have a web browser, and the USB output won't be compatible with current PC peripherals. Microsoft is entering a console arena in which the competition has at least a decade headstart, and it isn't even playing to its strength: convergence. In fact, Microsoft's announcement strongly emphasized the X-Box's *dis*-similarity with the PC, placing it squarely in the Dreamcast/PSX2/Dolphin camp.

If Microsoft had decided to produce a box that blended both approaches, it would have benefited everyone. Since, like all console companies, it is maintaining control over X-Box-labeled games, these games will have to be shipped finished; console titles need to be playable when they hit the jewel case, not a month later. Producing a game that plays on both the PC and set-top would have finally cornered companies into finishing their product before they sell it. On the set-top side, the addition of a keyboard peripheral and joystick rig would have finally brought complex sims and strategy games into living rooms. Such a box could have shocked this whole business and injected lifeblood into flagging PC sales—lifeblood that is now flowing into Dreamcast, and PSX2, and soon to X-Box.

Gamers drawn to the processing power of the PC are being lured to the console, and the market is once again contracting into a hobby market.

We need only look to the news for a hint as to why this dream machine is not to be. Imagine Microsoft putting *Internet Explorer* in your *living room*—this giant, Sherman-Act-violating, mega-corporation extending its tendrils that deeply into home entertainment. Microsoft is already facing divestiture for packing a browser with its OS. What if the company were to bring web browsing, online gaming, DVD movies, and crossover PC gaming to your TV? The console companies, DVD hardware makers, and web software companies would cry bloody murder. Microsoft would hold the keys to PC-TV convergence, and that much power would seriously spook the feds.

The X-Box was officially announced shortly before Microsoft was indicted. Certainly this timing played a role in the machine's final specs—after all, the "convergence version" of the X-Box could have been clinching evidence that Microsoft is trying to muscle into every corner of the consumer electronics market. But by emphasizing the X-Box's console-ness, its lack of a built-in browser, and its PC-unfriendly specs, Microsoft sought to dodge the anti-trust bullet.



T. LIAM MCDONALD is a veteran gamer and game writer. His reviews appear regularly in *PC Gamer* and other publications. Write him at **tmcdonald@maximumpc.com.**

So where are PC gamers after all this sturm und drang? Right back where we were before anyone heard of the X-Box. PC games will continue to ship unfinished. Companies such as Cavedog will continue to go under despite solid hits. Sales will continue to be lost to consoles. We could once point to slick graphics as justification for the hassle and expense of PC gaming, but the consoles stole that thunder, too. We have only the overall quality, diversity, and intelligence of PC games left to distinguish us from the platform users. Gamers drawn to the processing power of the PC are being lured to the console, and the market is once again contracting into a hobby market. That might not be a bad thing—as of now, budgets are bloated and far too much dumbed-down product is being released. But for a moment, it appeared that PC games would get better, PC gaming would come to the TV, and true convergence was possible. Monopolies aren't always a bad thing. ✹

Random Thought

▶ **Tribes 2:** Work on the sequel to this cult fave proceeds apace, with the expected improvements in graphics and gameplay. A more interesting change is the totally integral nature of the online utilities, including unique IDs, browsing, IMs, chat, and other features that make the community an element of the software itself.

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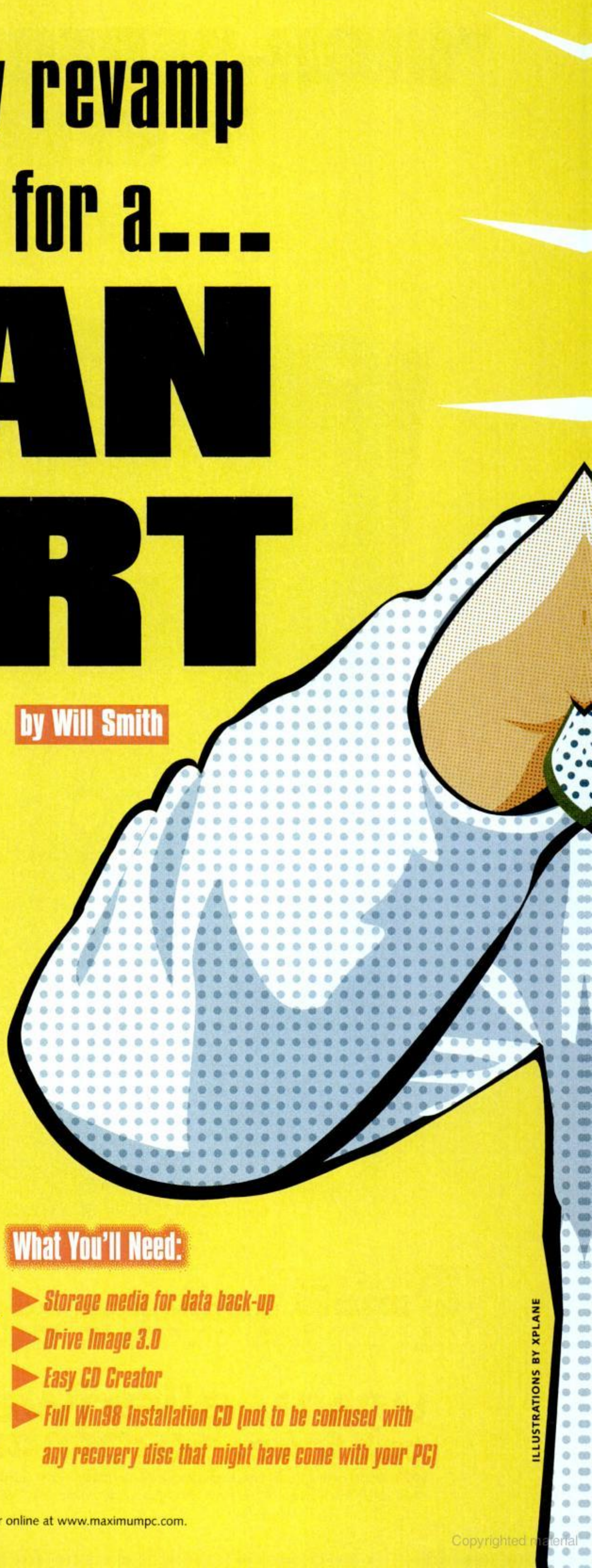


ILLUSTRATIONS BY XPLANE

Remember how zippy and responsive your PC was when you first brought it home? It hummed in anticipation of your keystrokes, opened windows almost before you clicked the mouse, and launched apps and as soon as you hit the Enter key. Now it seems to grumble and sputter through the simplest task, and threatens to throw a rod whenever you run anything more strenuous than *Solitaire*.

Before you think someone is sapping your CPU clock cycles to do another DoS attack, take a good hard look at your OS. See that waxy file buildup in your System directory? See those rotting bits of dead-end links clogging your Registry?

Continued on page 40

What You'll Need:

- *Storage media for data back-up*
- *Drive Image 3.0*
- *Easy CD Creator*
- *Full Win98 Installation CD (not to be confused with any recovery disc that might have come with your PC)*

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

Installing applications, grabbing gigs of MP3s from the net, even paying an occasional bill clutters up your system. Old downloads and temp files pile up like dust bunnies, and poorly written installers litter your Registry with detritus from applications you thought you'd removed months ago. An orphaned file here, a dead tree in the Registry there—pretty soon, Windows' drainpipes are royally clogged up. And when the junkpile gets too big, the only way to clean up the mess and ensure top performance from your PC is to format and reinstall Windows.

Don't let the phrase "format and reinstall" give you a coronary. If you consider exactly what's on your machine, you'll realize that not everything on your hard drive is irreplaceable; you just need to find the stuff that's worth keeping and store it elsewhere while you do some spring cleaning.

In the following seven pages, we'll show you how to rejuvenate your Windows PC. Once your vitals are secured, we'll show you how to wash the extra crap from your computer and leave it smelling fresh as a daisy. If your rig is so new that it still has that out-of-the-Styrofoam smell, check out the "Maintaining that Windows Sparkle" section for some advice on preventative maintenance that can keep bad things from happening to your good PC.

Once we get a fresh install of Windows 98 onto your computer, we'll show you how to tweak and tune, and give you some hints on organizing your files. Then we'll burn an image of your hard drive to a bootable CD, so you can restore your system to a pristine state without going through this entire process again.

Before you begin, read through the whole article, and be ready to back up your data—floppies are not going to cut it, Francis. Zip, Jaz, or CD-R are the order of the day for this operation. You'll also need a Windows 98 installation disc, and copies of *DriveImage 3.0* (**www.powerquest.com**) and *Easy CD Creator* (**www.adaptec.com**), to create a system-restore CD that's preloaded with all your favorite apps and settings.

Women and Children First

Be fully aware of what you're doing before you blindly FDISK your PC. You'll be doing a complete wipe of the hard drive, which means *all the information on it will be lost.* And all means all—all of your old e-mail, all of your bookmarks, all of your Internet connection settings, all of your saved games, fan letters, resumes, dirty JPEGs, and 14GB of MP3s. *They will all be gone.*

Unless, of course, you back them up first.

Before FDISKing, figure out which personal files are important to you and where they live on your hard drive, and back them up on the media of your choice, or on another machine. Don't even try to blame us if you lose your dissertation because you forgot to back it up. When we say everything must go, we mean it.

To help you out with the backup process, we've provided some hints on saving your stuff.

▶ **Backing Up E-mail and Bookmarks** If you're a *Eudora* user, your precious mail is stored in several files; for each folder in which you store mail, there is one .mbx and one .toc file in your *Eudora* directory. Simply grab every .mbx and .toc file in your *Eudora* directory (usually C:\Program Files\Qualcomm\Eudora).

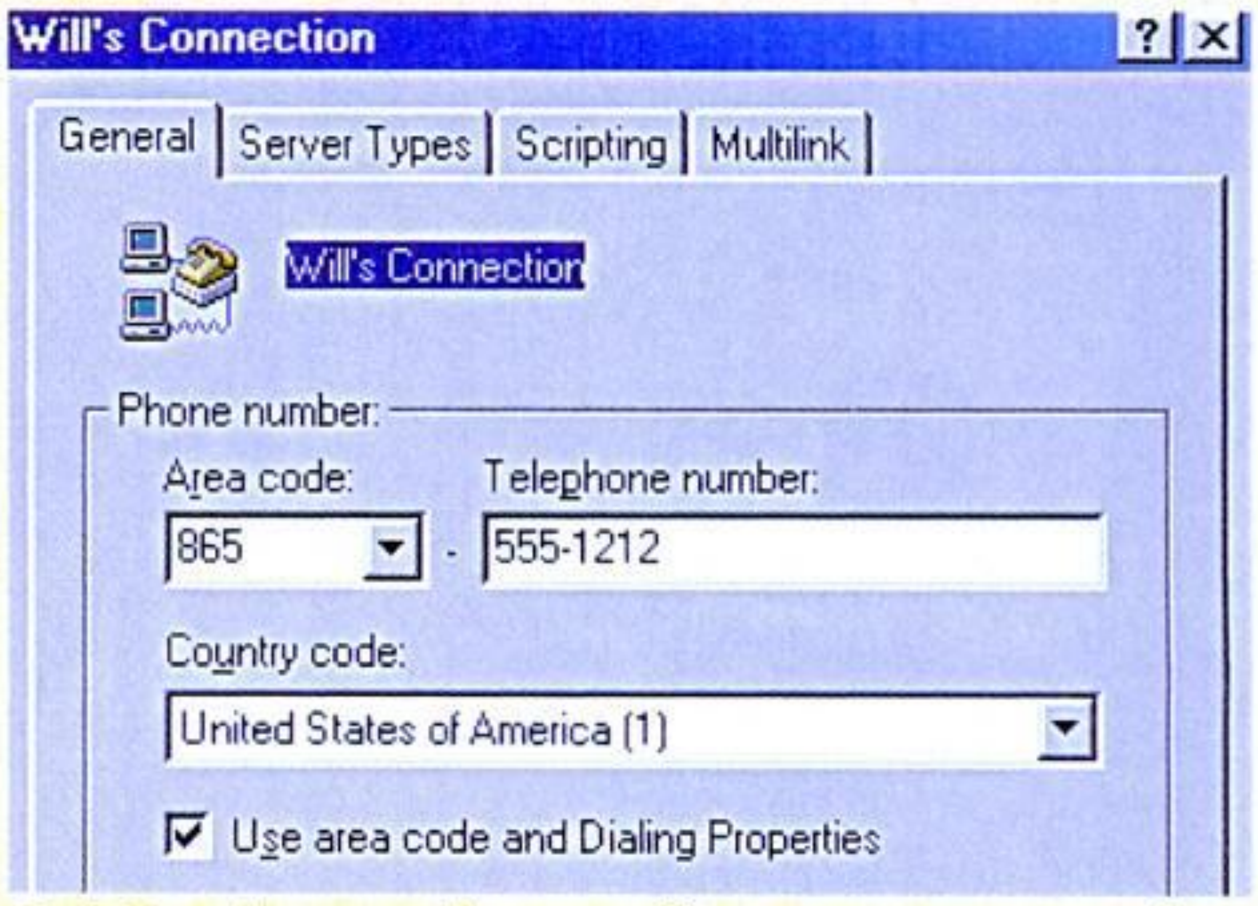
Outlook users only have one file to worry about—but, as is the case with many Microsoft products, it's stored in a confusing place. For *Outlook 2000*, the default mailbox is called outlook.pst. You can find it in your Windows directory under Application Data\Microsoft\Outlook\.

Netscape likes to keep everything—bookmarks and mail—in the Netscape directory. Look for your files in the default c:\Program Files\Netscape\Users\<username> directory, where <username> is your *Netscape* username. (If you don't know your *Netscape* username, don't panic—there's probably only one folder there.) Clear your disk cache in *Netscape* before backing up the file, so you don't end up saving six or seven MB of worthless files.

To secure your *Internet Explorer* bookmarks, go to the c:\Windows\Favorites directory, and just copy the shortcuts you see there.

▶ **Backing Up Dial-Up Networking Settings** If you use a modem, be sure to keep a record of your Dial-Up Networking settings. Open Dial-Up Networking connection properties in My Computer, and copy down your ISP's phone number. Be sure you know your login name and password. If you have a cable modem or DSL, your interface to the net is most likely a network card—be sure you have drivers for that card (most popular cards have drivers on the Windows 98 disk, but it's better to be safe than sorry), and that you've copied all the important settings from the Network Control Panel.

▶ **Backing Up Saved Games** Because each game saves your progress in a different way, we won't be able to help you with specific file locations. Of course, any directory named "Saved Games" is a dead giveaway, but if you don't see anything like that, we can recommend a slightly risky alternative: Uninstall the game and back up whatever's left in the directory that the game was installed in. The theory behind this trick



Will's Connection

Phone number:

Area code: 865

Telephone number: 555-1212

Country code: United States of America (1)

☑ Use area code and Dialing Properties

Grab the phone number, as well as your username and login from your ISPs Dial Up Networking connection, before you wipe your hard drive.

is that most uninstallers won't remove files that the original installer didn't place there, such as saved game files and configuration files. There's still a chance you could lose your saved games, but that just adds to the game's replay value, right?

▶ **Backing Up Personal Files** Last, but certainly not least, clean out the directories in which you store your personal files. The main directory is usually My Documents, although some people use their Desktop for a similar purpose. We also recommend doing a quick search for .doc, .jpg, .mpg, .mp3, and any other file extensions that might adorn items you've created, modified, or downloaded from the net. Game and application patches might also be worth backing up, if you still have them on your hard drive.

Unfortunately, for each app we cover, there are thousands that we can't. Dig around in manuals, online help files, and company web sites to find the default locations of your files if we don't cover your app. Most programs default to the My Documents directory, but if you can't find your files there, try digging through the application's directory.

Collect Your Essentials

Once all your data is securely stored elsewhere, it's time to procure the items you'll need in order to reinstall Windows after formatting the hard drive.

▶ **Windows 98 Startup Disk** This whole project could end in tears if you're staring at a blank hard drive and you don't have this disk. To create one, launch the Add/Remove Software Control Panel, go to the Startup Disk tab, hit Create Disk, and follow the directions. Since it includes CD-ROM drivers, the Win98 Startup Disk will enable you to launch a painless Windows installation from a DOS prompt.

▶ **Drivers** Without drivers, you won't be able to get your system back up and running. Microsoft has taken the time to find drivers for most hardware, but if the Windows 98 installation CD doesn't provide drivers for your more esoteric toys, go online *before* you format and reinstall Windows, and track down the latest drivers from the company that makes your hardware. For example, if you have a new motherboard, you could be up a stinky brown creek if Win98 doesn't support its chipset. This shouldn't be an issue if you're running an Intel BX (or older) chipset, but if you're running anything more recent—such as an AMD 750 or VIA KX133 for Athlon owners, or an Intel 820 or VIA Apollo Pro 133A for Pentium III fans—pay a visit to your motherboard manufacturer's web site and download the latest chipset drivers. If drivers for your modem or NIC aren't provided on the Windows 98 CD, download them as well. Be sure to do this *before* formatting your hard

drive, because no drivers means no working modem or network interface—which means no going online to get drivers.

Although you don't need to get them in advance, it's also handy to have the latest versions of your videocard and soundcard drivers.

Proceed with format (Y/N)?

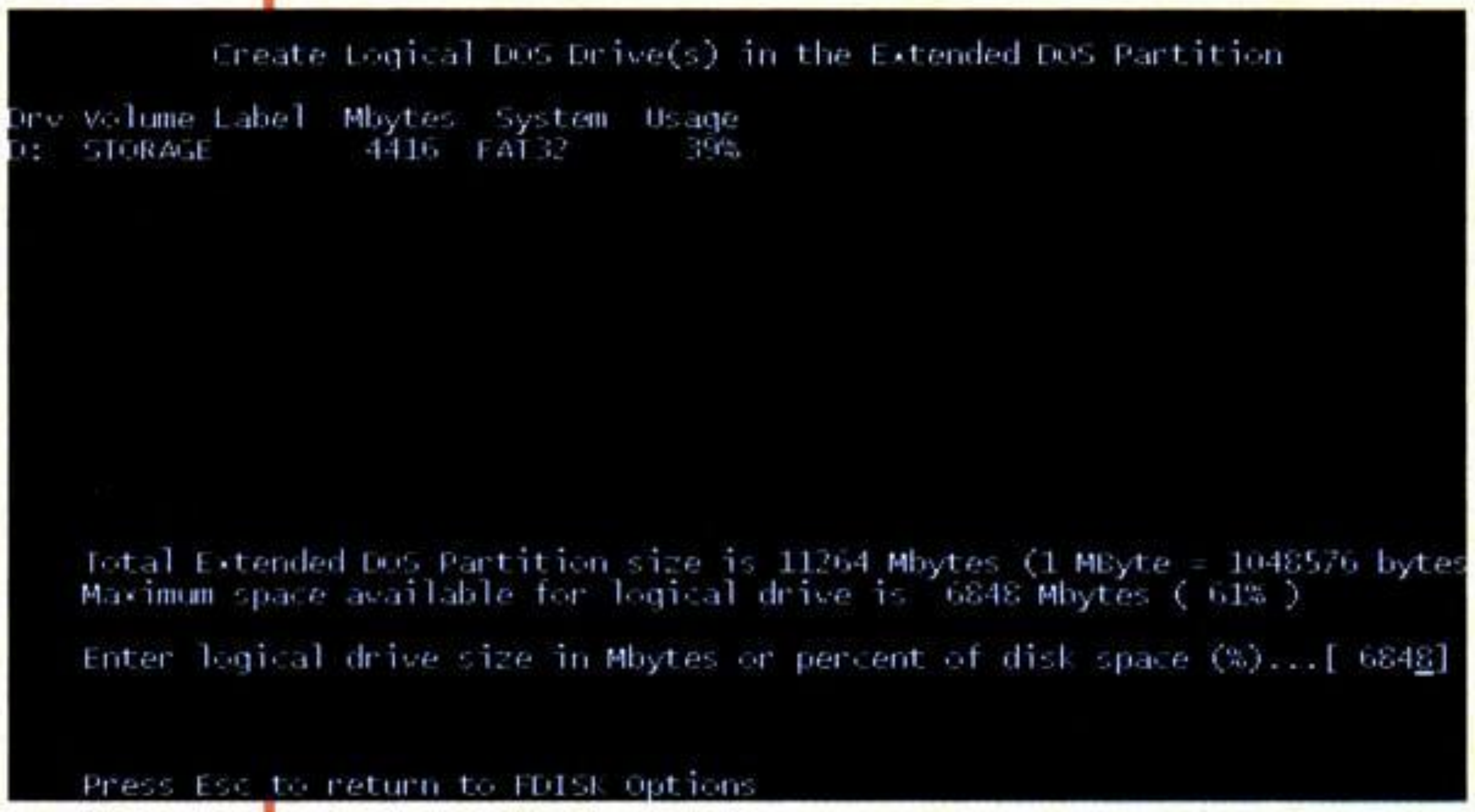
Up to this point, you haven't done anything irrevocable—but that's about to change. This is the point at which we de-gunk your hard drive of all the muck that's slowing it down, and also wipe the drive clean of all that makes it function.

Before we continue, we'll assume that you've made a Windows 98 startup disk and obtained a copy of the Windows 98 CD. We'll also assume that there's nothing on your hard drive that you really want but haven't backed up, because the drive is about to get flushed.

Before busting out the squeegee, test your startup floppy: Shut down Windows, insert the disk, and restart your computer. You should answer yes to the question about CD-ROM support, to verify that your CD works with the drivers on the startup disk. After you've booted up, you'll have at least four drives available to you: A: (your floppy); C: (your filthy old hard drive); D: (your CD-ROM drive); and E: (a special RAMdisk, where Windows stores important utilities too big to fit on the floppy). If you're sure you're ready to begin, type FDISK, press Enter, answer yes to the question about large hard disk support, and you're on your way.

If you're new to disk partitioning, here's a primer: Each physical hard drive in your computer can be subdivided into partitions. While some OSes (such as Linux and Windows 2000) treat different partitions as folders within a drive structure, Windows 98 sees each partition as a separate drive letter. FDISK is the utility included with Windows 98 that allows you to create, delete, and manage hard drive partitions.

If your computer has only one hard drive, choose option 3 (Delete partition or logical DOS drive), then option 1 (Delete Primary DOS partition) to blow away the partition that holds your old Windows system. FDISK will prompt you several times for confirmation, and ask you to type in the volume label (that is, the name) of your hard drive. After this sequence of events, all of the data that's sitting on your drive is obliterated. You have officially passed the point of no return, Pablo.

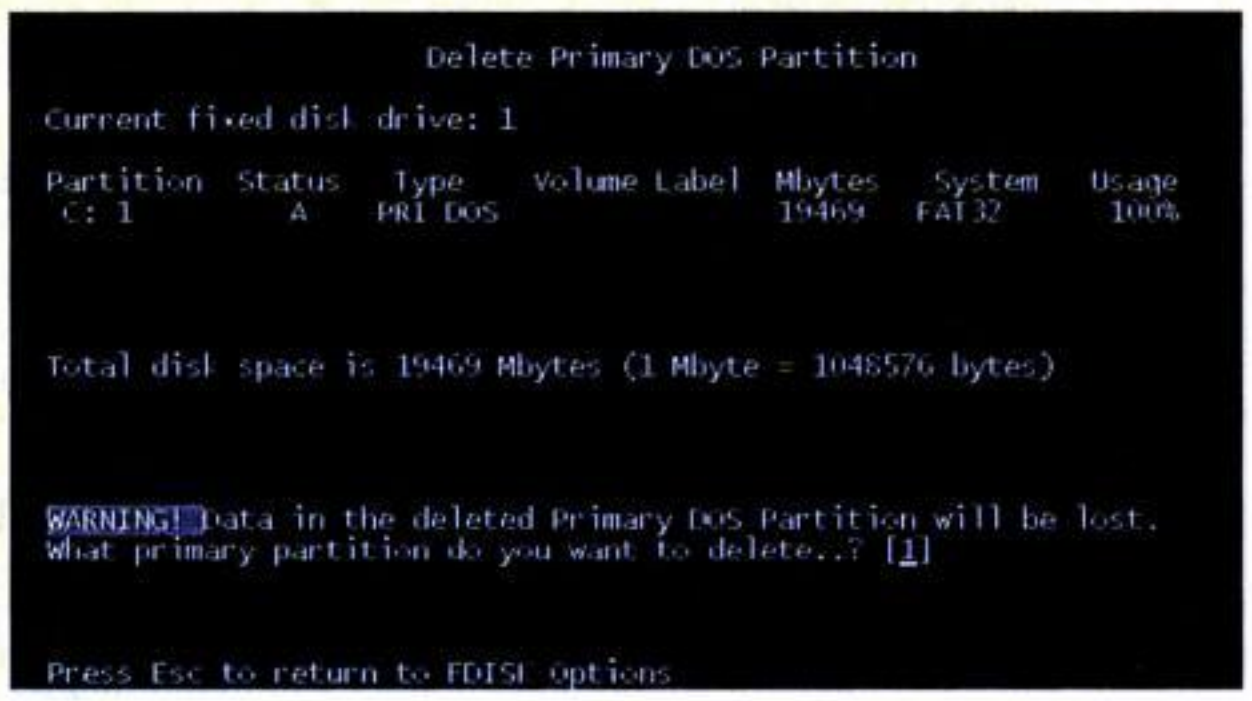


```
           Create Logical DOS Drive(s) in the Extended DOS Partition

Drv Volume Label  Mbytes  System  Usage
D:  STORAGE         4416  FAT32     39%











    Total Extended DOS Partition size is 11264 Mbytes (1 MByte = 1048576 bytes
    Maximum space available for logical drive is  6848 Mbytes ( 61% )

    Enter logical drive size in Mbytes or percent of disk space (%)...[ 6848]



    Press Esc to return to FDISK Options
```

Don't forget to create an extended partition so your logical drive has a home.

With your primary partition gone, you'll need to give your disk some structure by creating a few new partitions. To create the orderly computing environment that so many lust for but few achieve, we usually recommend two partitions: one for the OS, swapfile, and apps that you will *always* have on your computer, and one for other apps (you know, all that crap you download from the net), games, and data. This is our first line of defense against hard drive clutter. We recommend partitions sized between two and three gigabytes for your C: drive, which will hold the OS; use the rest of the hard drive for the D: partition.

To create your C: partition, return to the main FDISK menu, choose selection 1 (Create DOS partition or logical disk drive), then hit 1 again (Create a Primary DOS partition). Do *not* choose to use the maximum available amount of disk space, or you'll have one big-ass partition hogging everything. Instead, press N and set the size to somewhere between 2,000 and 3,000 megabytes. Make your new partition active by choosing option 2 from the main FDISK menu (Set partition active). By making your partition active, you tell the BIOS where it should look for booting instructions.



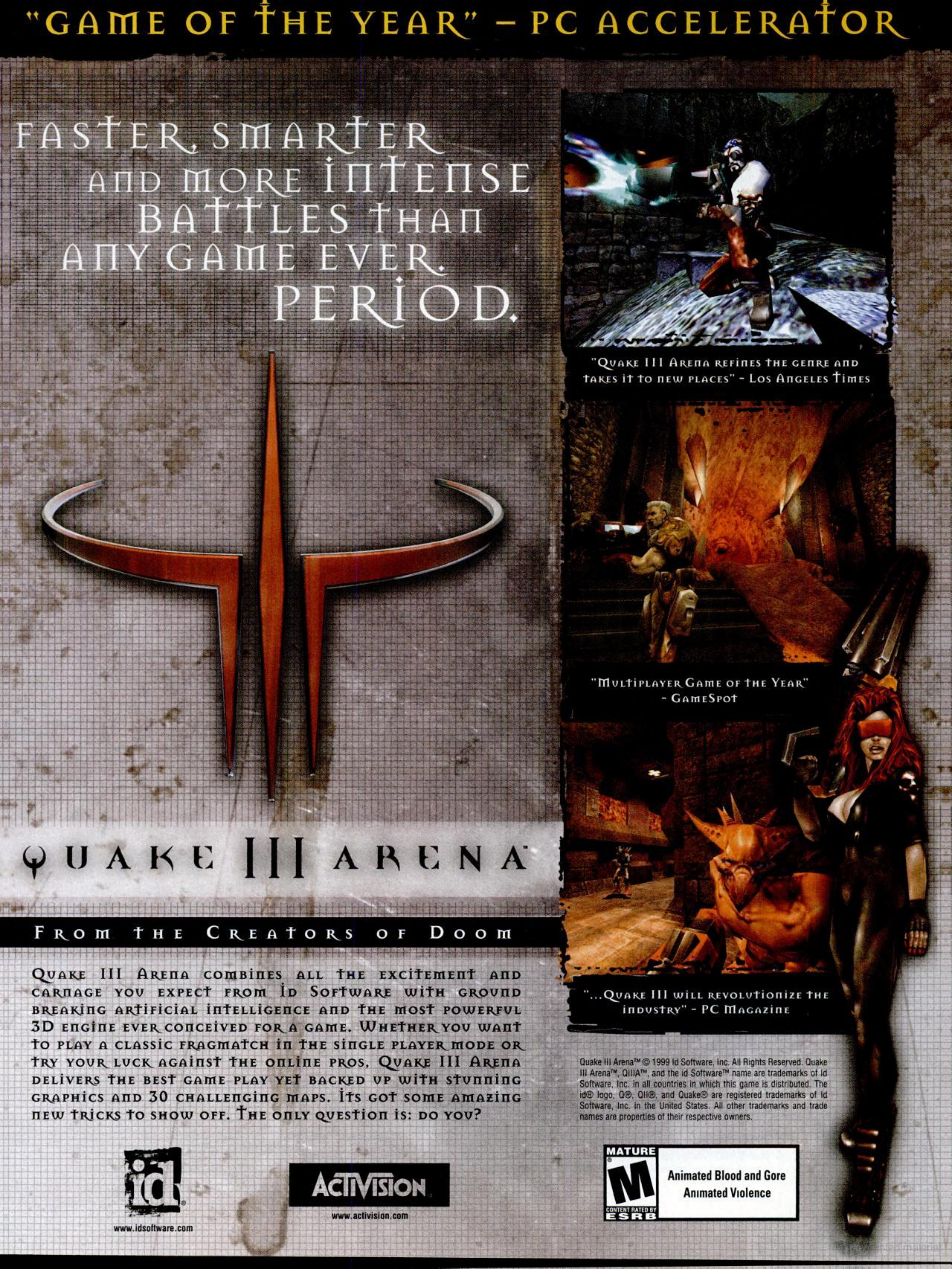
```
                        Delete Primary DOS Partition

Current fixed disk drive: 1

Partition  Status   Type    Volume Label  Mbytes   System   Usage
 C: 1         A    PRI DOS                 19469   FAT32     100%



Total disk space is 19469 Mbytes (1 Mbyte = 1048576 bytes)



WARNING! Data in the deleted Primary DOS Partition will be lost.
What primary partition do you want to delete..? [1]



Press Esc to return to FDISK Options
```

Be sure you really want to delete your partition before getting to this stage, because there's no going back.

Creating the D: partition is a little trickier. Your PC, unfortunately, is unable to host more than four primary partitions on a single hard drive. Like DOS's 640K memory limit, this is one of those legacy issues that's been worked around instead of fixed. Rather than mucking with the existing partitioning standard, Microsoft decided it would be easier to force users to subdivide their primary partitions. Thus was created the extended partition, which acts like a primary partition but can be divvied up into four logical partitions.

This is important: Because Win98 can only see one primary partition, the FDISK utility won't allow you to create more than one. To use the part of your hard drive that's not taken up by your primary C: partition, you'll need to create a logical partition D: within an extended partition.

To create D:, boogie on back to the main FDISK menu. Choose option 1, then choose option 2 (Create Extended DOS Partition). You can safely use the default size if you want to completely fill your disk (a good idea, unless you



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Quake III Arena combines all the excitement and carnage you expect from id Software with ground breaking artificial intelligence and the most powerful 3D engine ever conceived for a game. Whether you want to play a classic fragmatch in the single player mode or try your luck against the online pros, Quake III Arena delivers the best game play yet backed up with stunning graphics and 30 challenging maps. Its got some amazing new tricks to show off. The only question is: do you?

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MATURE
M
CONTENT RATED BY ESRB
Animated Blood and Gore
Animated Violence

www.idsoftware.com

ACTIVISION
www.activision.com

plan to install additional OSes). After the extended partition is created, FDISK will prompt you to create a logical partition. Choose the default, and fill the entire extended partition with your lemony fresh logical drive.

Now, reboot your computer from the Startup Disk, again enabling CD-ROM support. Go to the RAM disk by typing E:. Then format the C: drive to be bootable by typing FORMAT C: \S (the \S makes C: bootable). After C: is formatted, do the same to D: by typing FORMAT D:.

It's now time to copy the Win98 setup files to the D: drive. To do that, enter this set of commands:

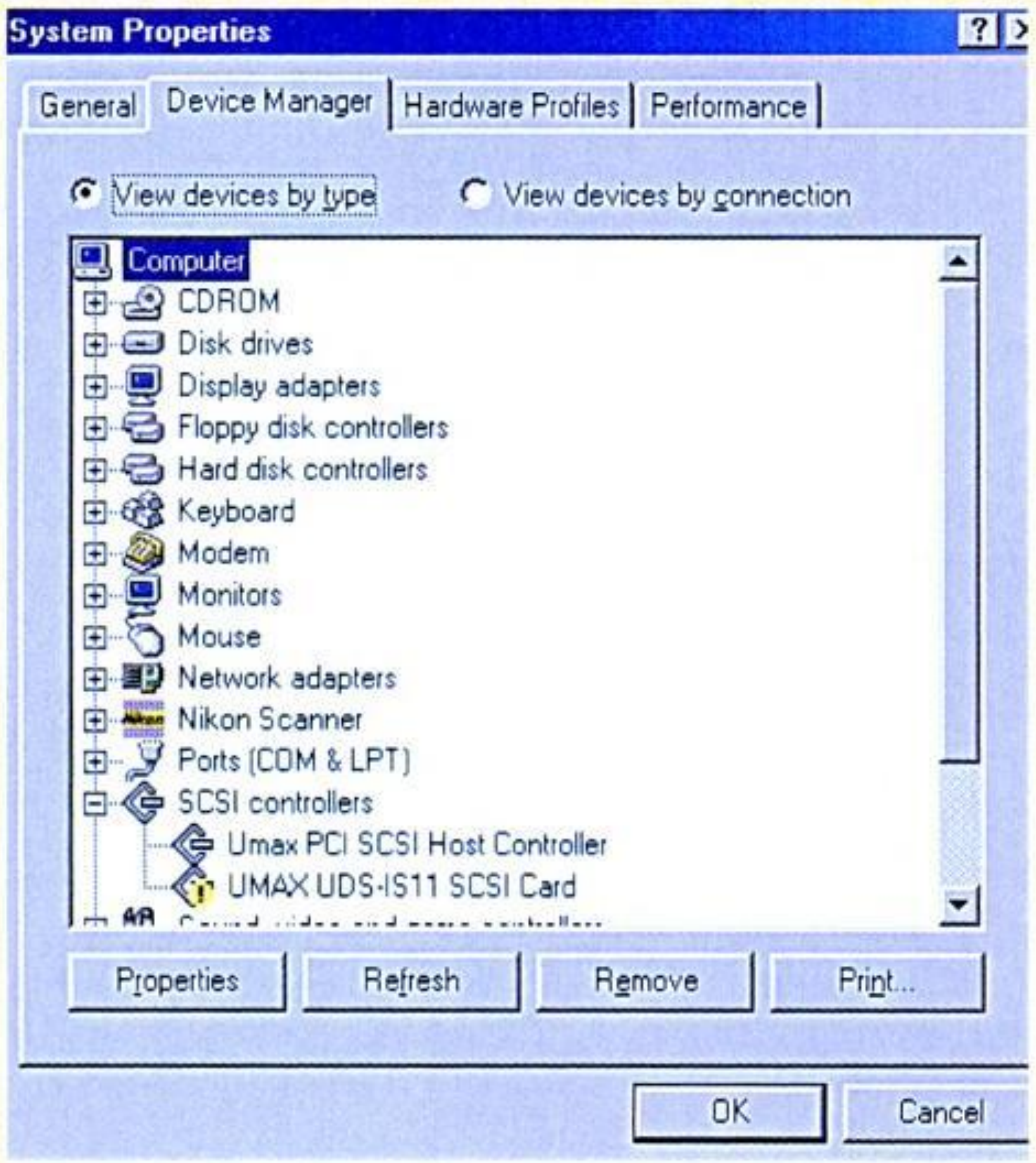
```
D:
md win98
cd win98
copy f:\win98\*.*
```

When everything is copied over, you're ready to install a newer, cleaner-smelling Windows. Get your installation disk ready!

Software Installation Mojo

Type d:\win98\setup.exe and follow the installation prompts. When Setup asks if you want to perform a custom install, choose yes, and remove things you'll never use, such as Online Services and MS Backup (for tape and floppy drives). A custom install also allows you to load some useful tools that aren't default choices, such as the Clipboard Viewer and Character Map (both can be found in System Tools).

Reboot and let Windows detect all your hardware; install the latest drivers (some of which you may have collected from vendor web sites) and reboot again. You're now ready to install those apps that you'll *always* have on your computer.



If you have hardware that isn't detected correctly or that Windows can't find drivers for, it will show up in Device Manager with an exclamation mark next to it.

Consider the ways you use your computer. You have a core set of applications and games that are always installed and heavily used, such as your e-mail program. You probably also have some other apps that are always installed, but used only every month or so. And then there are the apps and games that you virtually never use. Where do you want to store this stuff?

Our suggestion is to load your C: drive with all the proggies you use regularly and can't live without. Since the C: drive holds Windows and its swap file, it's nice to have your vital apps stored here as well, so you can simply back up the entire drive partition in one fell swoop when making a recovery disk (which we'll do later). Store all the stuff that's constantly being updated, such as your mail, onto your D: drive. This will allow you to safely overwrite C: at any time, refreshing your system installation without wiping out your continuously updated data.

Now get to work configuring your e-mail account, installing your instant messaging client, CD burning software, office productivity suite, MP3 utilities, system utilities, virus checker, and anything else you get a groove on with. Put the files you backed up in their appropriate locations, and be sure that all your hardware is working properly. You downloaded the latest versions of all your drivers, right?

Tweaking the Night Away

Now, the fun part: Windows is up and running, and you've installed all your favorite applications on your hard drive. It's time to make Windows look, perform, and behave exactly the way you want it to.

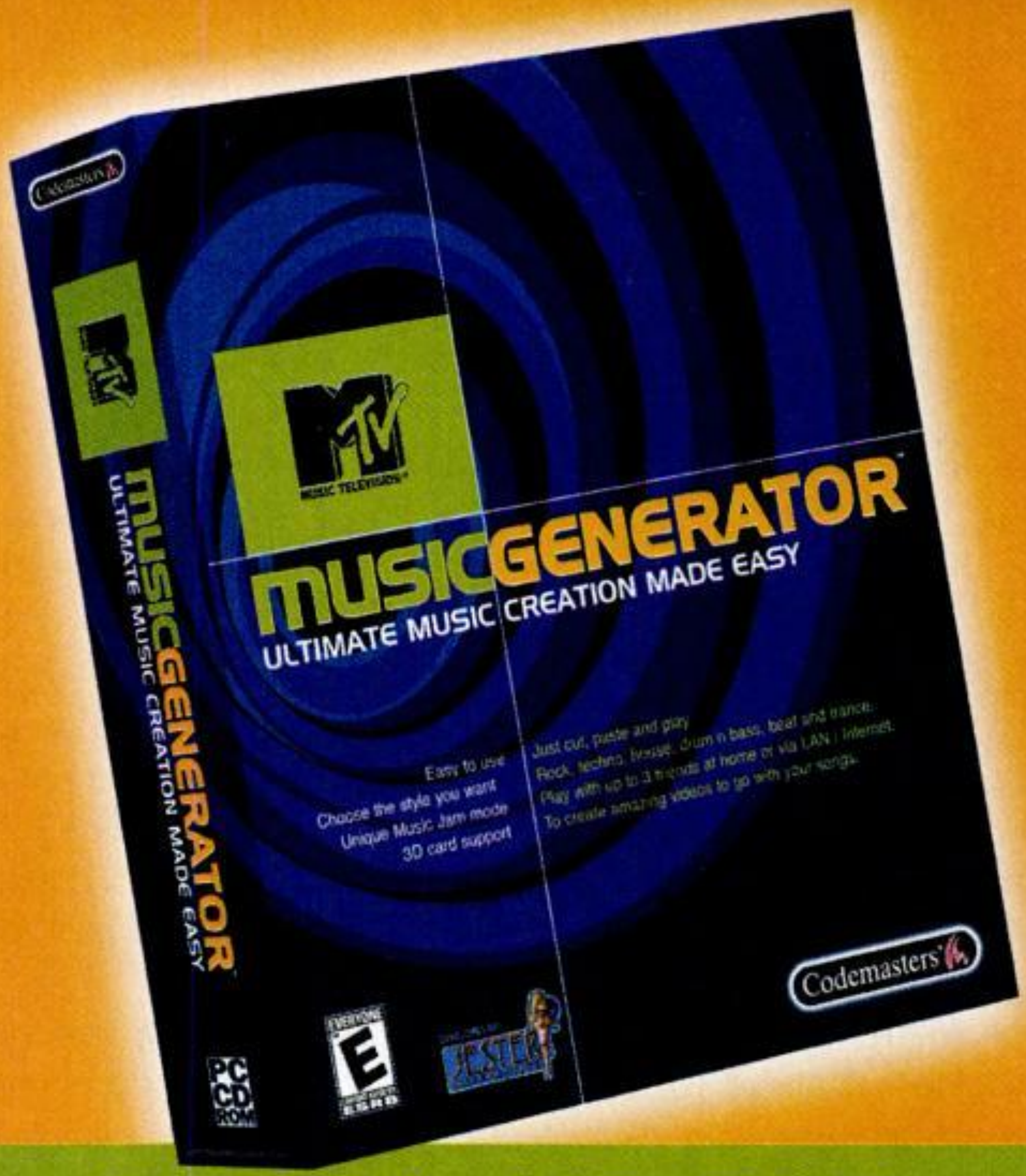
▶ **Clean up the System Tray** It seems that many programmers feel their apps deserve a memory-hogging spot in the System Tray. Yours is probably being occupied by an instant messaging client, an anti-virus program, and an icon that lets you change monitor resolutions. Those are OK. But there are others there that you've never used. They're completely unnecessary, and can be replaced with shortcuts in the Quick Launch toolbar that don't take any memory.

You can usually get an idea of what program is associated with a System Tray icon by resting the cursor over the icon for a few moments; usually, an application name or some identifiable moniker will pop up. If not, try right-clicking or double-clicking on the icon.

Numero uno on our System Tray hit list is the Task Scheduler, brought to us courtesy of Microsoft. We haven't found a use for it yet, so we killed ours a long time ago. Just double-click on the Task Scheduler icon, go to the Advanced menu, and choose Stop Using Task Scheduler. You should never see it again. We say, "Good riddance!"

Getting a particular program to automatically start up every time Windows launches is a matter of placing a shortcut to it in the Startup folder located in the Start Menu (C:\Windows\Start Menu\Programs\Startup). Quite a few of the programs residing in your Tray probably have shortcuts in that folder—deleting the shortcuts will stop them

HARD AS HELL.


MTV MUSIC TELEVISION
musicGENERATOR
ULTIMATE MUSIC CREATION MADE EASY
Easy to use
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Unique Music Jam mode
3D card support
Just cut, paste and play
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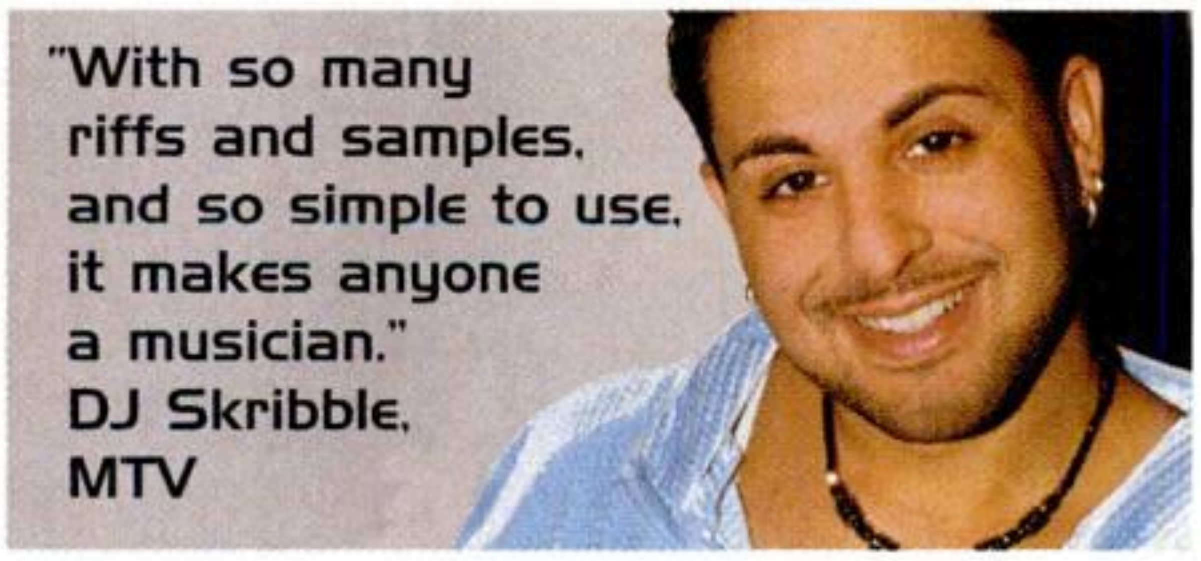

"With so many riffs and samples, and so simple to use, it makes anyone a musician."
DJ Skribble,
MTV

- Easy-to-use interface lets you create, record and edit tunes note-by-note
- Combine 1,000 riffs and 3,000 instrument sounds in 99 audio channels
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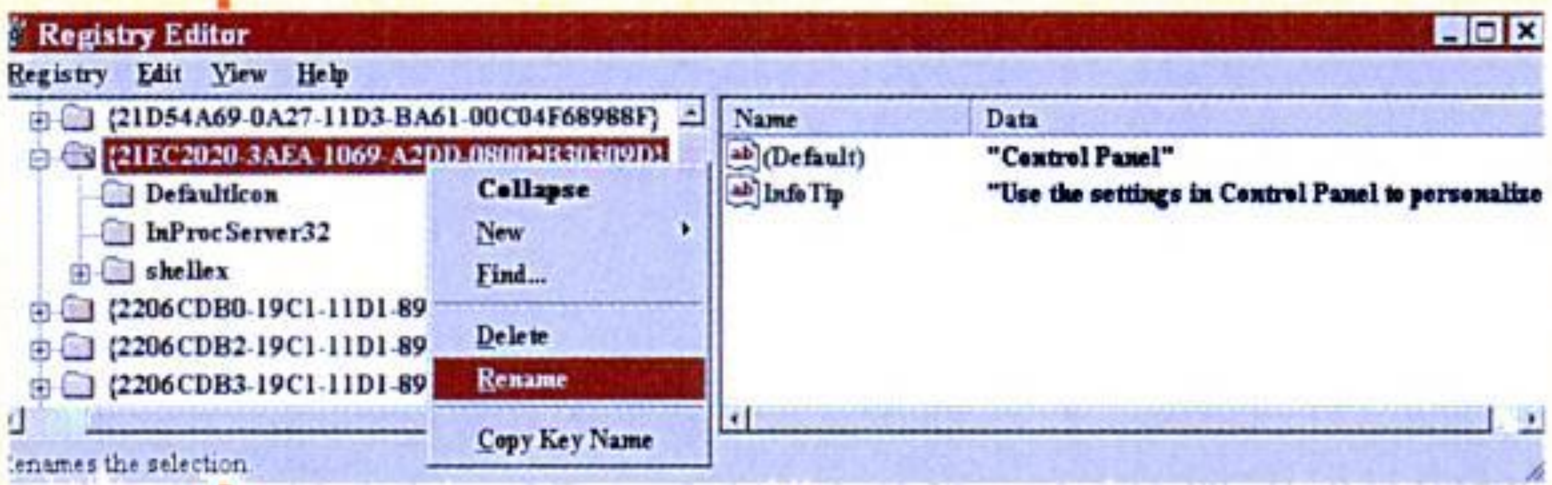
from loading. Go through that folder and take care of anything that's not absolutely necessary, Godfather style.

Another place to look for auto loading programs is the Registry. If you're comfortable using the Registry Editor, browse to the KEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Run key and remove any extraneous BS that you find there. An easier way to do this is by using the System Configuration Utility. Typing MSCONFIG in the Start Menu's Run box is the quickest way to launch the utility. From there, go to the Startup tab and remove the checkmarks from anything you don't want to load automatically.

▶ Put the Control Panel on the Start Menu Our next tweak puts a popup Control Panel on the Start Menu. Open Windows *Explorer* and head to C:\Windows\Start Menu. From within this directory, create a new folder called "Control Panel" (without the quotes). Now launch Regedit by typing REGEDIT in the Start Menu's Run box, and search (under the Registry Editor's Edit menu) for "Control Panel" (again, without the quotes). A list of folders should pop up in the left-hand pane of the Registry Editor. Find the only open folder, which should be in the HKEY_CLASSES_ROOT\CLSID tree. The open folder's name should be a really long list of letters and numbers—otherwise knows as a CLSID. Grab that CLSID sequence by right-clicking on the folder, choosing Rename, and pressing ctrl+c to copy the file name. Exit the Registry Editor without making any changes, and head back to that *Explorer* window we left open. Rename the folder you originally named "Control Panel" by appending the text you copied (it should look like "Control Panel.CLSID," where CSLID is the long number you copied). You should now have a fully functional popup copy of the Control Panel in your Start Menu.

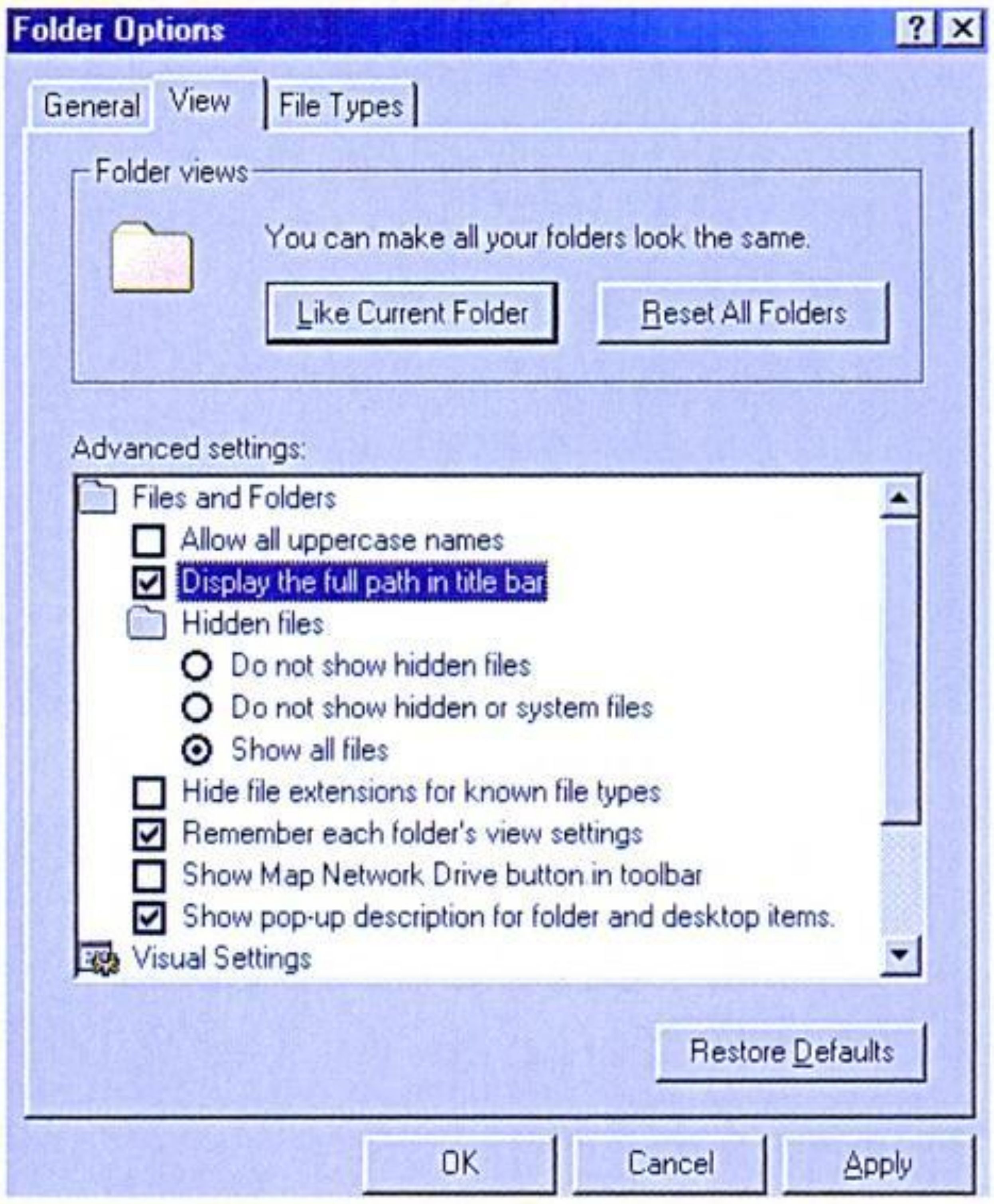

Registry Editor
Registry
Edit
View
Help
{21D54A69-0A27-11D3-BA61-00C04F68988F}
{21EC2020-3AEA-1069-A2DD-08002B30309D}
DefaultIcon
InProcServer32
shellex
{2206CDB0-19C1-11D1-89
{2206CDB2-19C1-11D1-89
{2206CDB3-19C1-11D1-89
Collapse
New
Find...
Delete
Rename
Copy Key Name
Renames the selection.

Name	Data
(Default)	"Control Panel"
InfoTip	"Use the settings in Control Panel to personalize

If you want an expandable Control Panel in your Start Menu, the easiest way to get it is to grab the CLSID from the registry.

▶ Make Windows show everything Everyone has his or her own preferences when it comes to how Windows is set up, and many people get thrown into a tizzy if things aren't just so. So why accept the default view settings for Windows files and folders? Viewing folders as web pages, hiding system files, and displaying file attributes are all toggles you can play with in Folder Options, which can be found in the Start Menu under Settings.

The first thing you should do is switch the View Web content to "Only for folders where I select 'as Web Page,'" so you don't have to bog your system down with HTML pages telling you information you already know about the files that you're selecting.


Folder Options
General
View
File Types
Folder views
You can make all your folders look the same.
Like Current Folder
Reset All Folders
Restore Defaults
OK
Cancel
Apply

Advanced settings:

Files and Folders
- ☐ Allow all uppercase names
- ☑ Display the full path in title bar
- Hidden files
  - ○ Do not show hidden files
  - ○ Do not show hidden or system files
  - ● Show all files
- ☐ Hide file extensions for known file types
- ☑ Remember each folder's view settings
- ☐ Show Map Network Drive button in toolbar
- ☑ Show pop-up description for folder and desktop items.

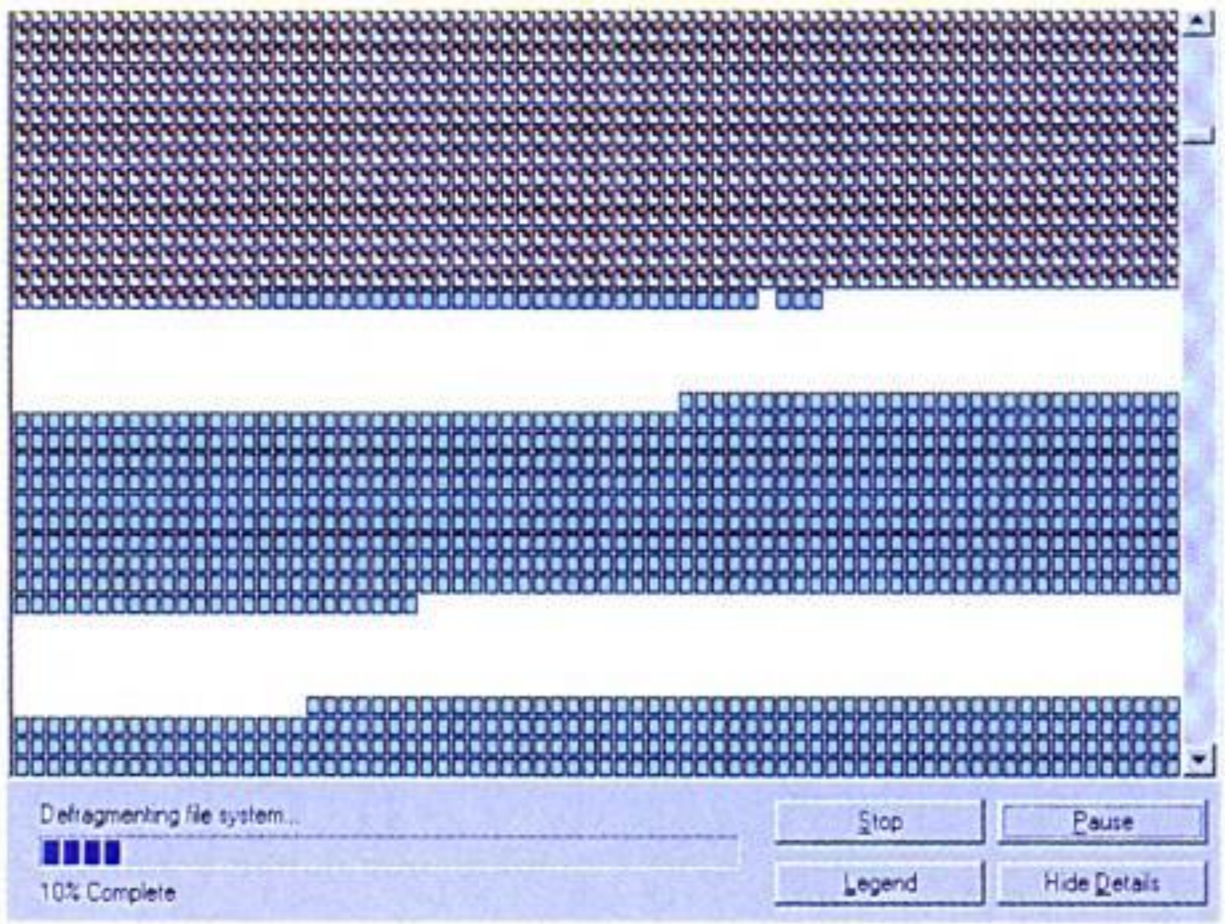
Visual Settings

Changing View settings is vital to your continued sanity. Allowing the OS to hide file extensions and system files breeds nothing but confusion.

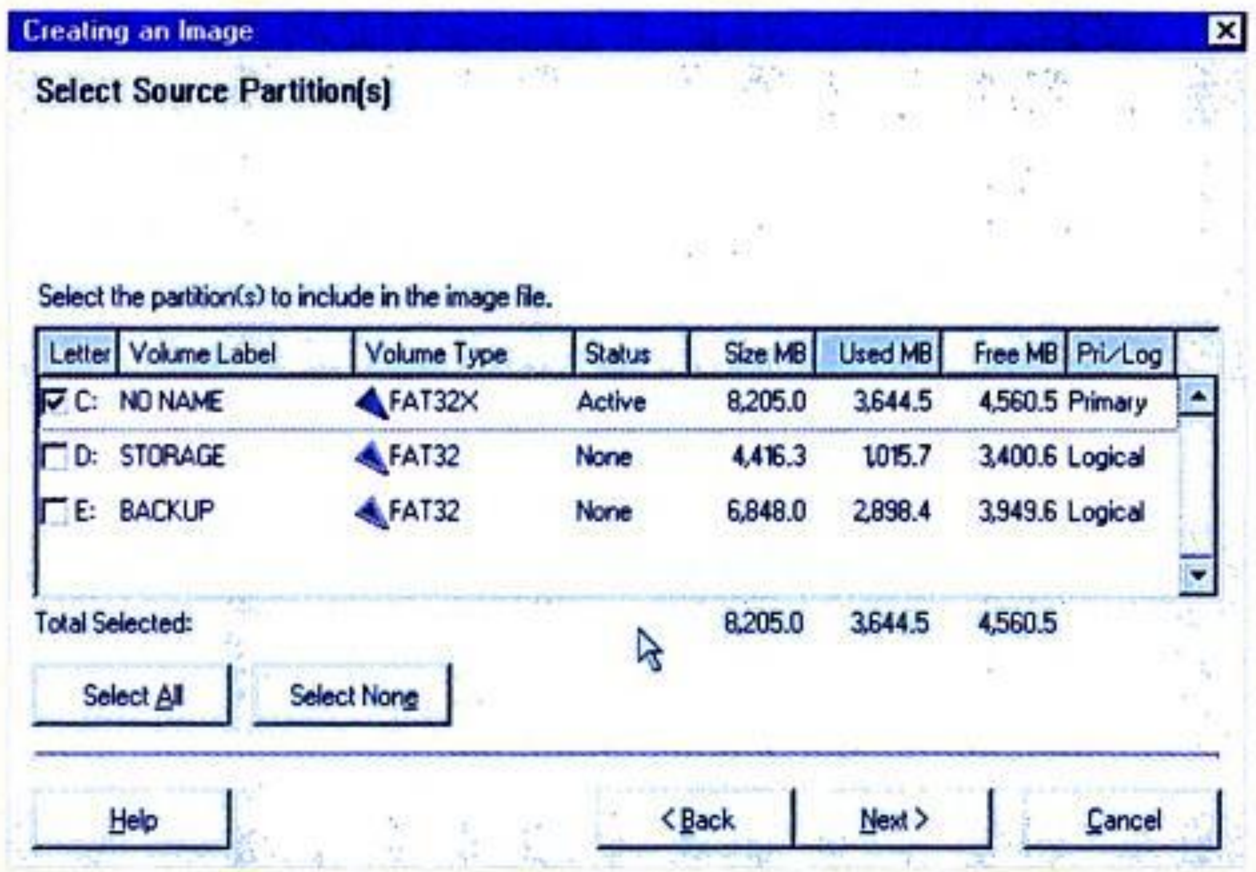
Apply these changes and hit the View tab to bring up the Advanced View settings for your files and folders. By changing "Do not show hidden files" to "Show all files," and unchecking the "Hide file extensions for known files types," you'll make Windows reveal all of its dirty little secrets, and gain more control over your system.

▶ Defrag the swap file The last phase of this Windows cleaning project involves making a recovery disk. But unlike a simple backup, in which individual files are copied to a tape or other media, you'll be creating a mirror image of your C: drive. And because drive images retain the structure of the original hard drive—including file system errors and fragmentation—you'll want to fully defragment the hard drive (and the swap file) before you make your image.

Defragging the swap file is easy if you have Norton's


Defragmenting file system...
10% Complete
Stop
Pause
Legend
Hide Details

The Windows defragger can't move the swap file (the little red boxes at the top). If you don't zero it out, the defragger won't be able to fully optimize your hard drive.



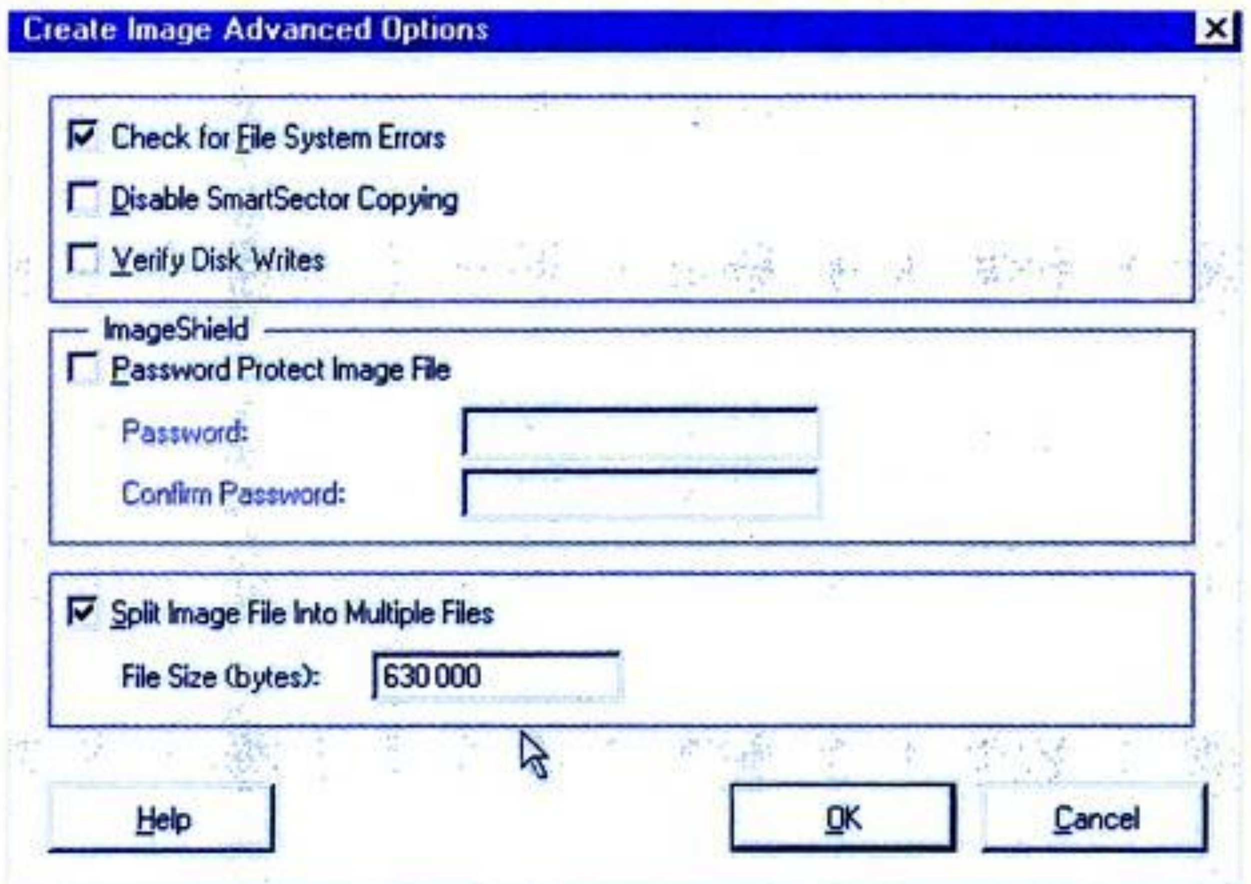
Creating an Image

Select Source Partition(s)

Select the partition(s) to include in the image file.

Letter	Volume Label	Volume Type	Status	Size MB	Used MB	Free MB	Pri/Log
☑ C:	NO NAME	FAT32X	Active	8,205.0	3,644.5	4,560.5	Primary
☐ D:	STORAGE	FAT32	None	4,416.3	1,015.7	3,400.6	Logical
☐ E:	BACKUP	FAT32	None	6,848.0	2,898.4	3,949.6	Logical
Total Selected:				8,205.0	3,644.5	4,560.5	

PowerQuest's *DriveImage* will allow you to make an exact duplicate of your shiny new Windows install, so you'll be able to do a complete restore any time you'd like.



Create Image Advanced Options

☑ Check for File System Errors
☐ Disable SmartSector Copying
☐ Verify Disk Writes

ImageShield
☐ Password Protect Image File
Password:
Confirm Password:

☑ Split Image File Into Multiple Files
File Size (bytes): 630 000

If you want your hard drive image to fit on a CD, be sure to tell *DriveImage* to split it into multiple 630MB sized files.

Speed Disk or another defragmentation utility that's clever enough to handle the file properly. Unfortunately, the default Windows defragger can't take care of the task. To manually defrag the swap file, go to the System Properties Performance tab and look at the Virtual Memory button. Change it to "Let me specify my own virtual memory settings," set both the minimum and maximum swap file size to 0, press OK, and reboot when you're prompted to.

When you restart, immediately run the Disk Defragmenter on drive C:. After it's done, go back to the Virtual Memory settings page and set the minimum and maximum size to two times the amount of system RAM. Choose the same size for both settings, but don't exceed 256MB. Reboot again. Setting a maximum and minimum swap file size keeps Windows from constantly resizing your swap file, which causes it to get terribly fragmented in a very short period of time.

Creating a System Restore Disk

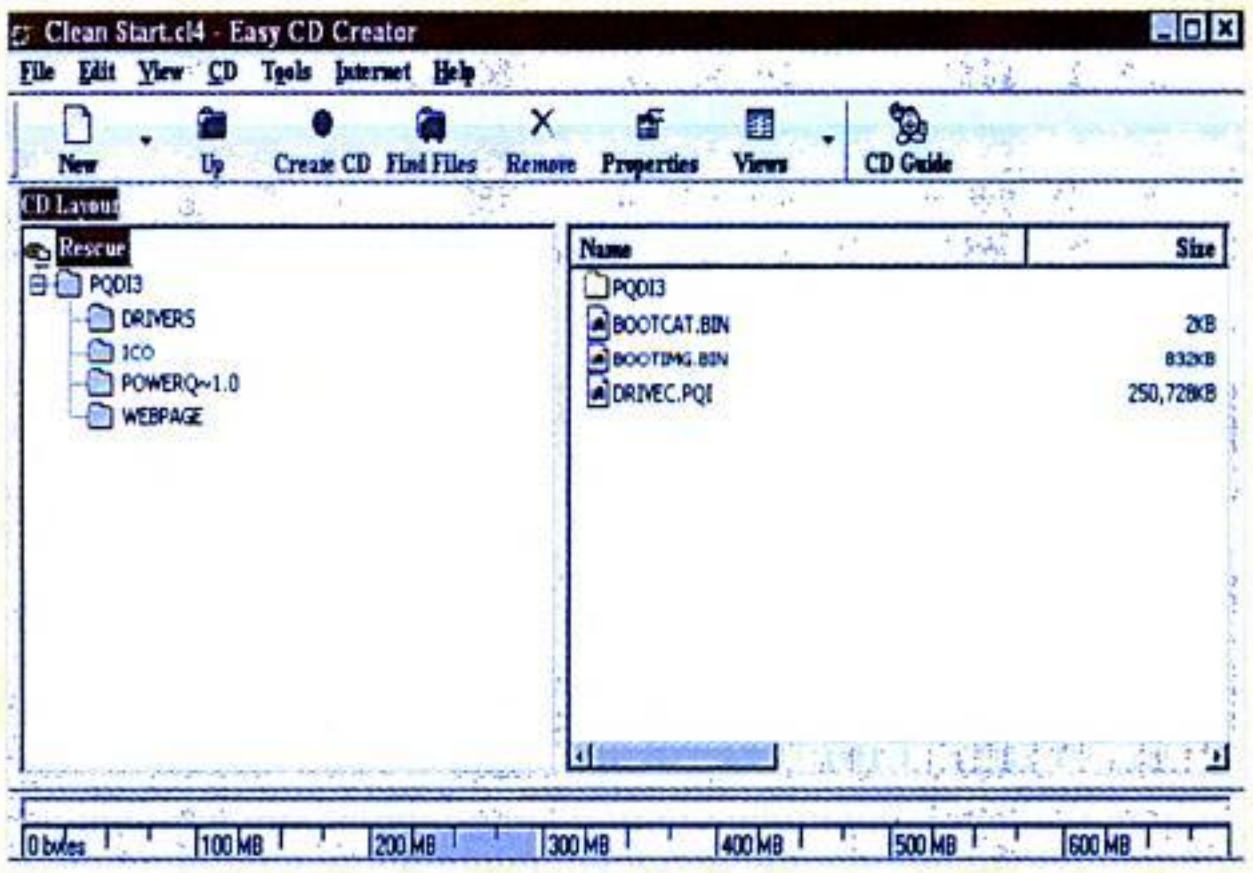
Now that your Win98 install is squeaky clean, it's time to create a disk image that you can burn to CD. The goal is to take a snapshot of your hard drive in its most pristine state, so that when everything goes to hooey, you can simply boot from the CD and replace your filthy system with the clean one. We're mainly concerned with backing up the C: partition, since it contains Windows and all of your vital apps.

We chose PowerQuest's *DriveImage 3.0* to create and compress an image of our C: drive. We installed *DriveImage* on D:, so it was out of the way of the C: drive we were imaging. *DriveImage* doesn't write its hard drive image files to CD (yet), so you'll need to save the C: drive image file to D:. Got that? Be sure *DriveImage* is set to "high" compression, and that it's set to create multiple 630MB images (look in the Advanced Options menu for spanning options), because they're perfectly sized to fit on a CD, which is where you'll be moving them later. Also be sure that your D: partition has sufficient space to hold a 630MB image file.

After creating your image, burn it to CD. You'll need a CD mastering program that can make a bootable disk—we used *Easy CD Creator 4*. Other than blank CD-R media, the only other thing you'll need is a Win98 Startup disk. Open *Easy CD Creator* and choose Bootable CD from the New CD Layout menu. When *CD Creator* asks you for a bootable floppy, insert your Win98 Startup Disk and let the program convert the boot information into the appropriate format. Add the image file of your C: drive to the disk layout. Then add the *DriveImage* program directory (usually something like d:\pqdi3), and all the files in it. Hit the Create CD button to begin burning, and you'll be ready to begin the rest of your life.

After you've successfully burned a restoration disk, test it out. Be sure your BIOS is set to allow booting from CD, then pop the disk into your CD-ROM drive and reboot the computer. Your computer should boot as though it were starting from the Win98 startup disk. When you get to a command prompt just type X:\pqdi3\pqdi (where X is your CD-ROM drive letter). If you see the familiar *DriveImage* interface, you've done everything correctly and now have a bootable CD from which you can restore a fresh copy of Windows 98, anytime you want.

Your clean-up is done. You should never have to wipe and reinstall Windows again.



Clean Start.cl4 - Easy CD Creator

CD Layout

Rescue
- PQDI3
  - DRIVERS
  - ICO
  - POWERQ~1.0
  - WEBPAGE

Name	Size
PQDI3	
BOOTCAT.BIN	2KB
BOOTIMG.BIN	832KB
DRIVEC.PQI	250,728KB

Use Adaptec's *Easy CD Creator* to make a bootable CD complete with the *DriveImage* application files and a squeaky clean image of your hard disk and favorite apps for quick and easy system restores.

Maintaining That Windows Sparkle

Here are a few simple things you can do to keep your system from falling into disrepair.

Nothing hurts performance like an unhealthy file system, so maintaining your drives is a task of primary importance. Running the occasional Scandisk will keep bad hard drive clusters from raining on your parade; that should be done at least once a week. Regularly running Windows Defrag or Norton *Speed Disk* not only keeps your system from slowing down every time it has to piece some files together, but also helps keep your system zippy by moving your most-often-used files to the fastest areas of your hard drive.

Another contributor to your system's slowdown is a clogged Registry. After installing and uninstalling a lot of games and applications, your Registry can get overloaded with dead-end links, circular references, and useless data. A clean Windows install is the sure-fire way to fix an overweight and unhealthy Registry, but there are alternatives to this shotgun approach. Microsoft's *RegClean* utility (available on the Maximum CD and at Microsoft's web site) can go a long way toward solving Registry problems specific to Microsoft products, but for the real deal you need a utility such as Norton *WinDoctor*, which digs through your Registry and removes corrupted, unnecessary, and outdated Registry keys. The effects of this regular Registry maintenance may not be immediately obvious (you won't net an extra 10fps in *Quake III* or anything), but regular maintenance can drastically improve load times for both the OS and individual applications.

When it comes to general Windows memory issues, there isn't a magic little utility that's going to solve all of your problems. You will eventually experience memory leaks that bog down your overall performance, and inane little background tasks will soak up CPU clock cycles. The Windows architecture is designed to place the onus of memory management on the applications, not on the OS, so the best thing to do is to pay very close attention to what's running on your PC at any given moment, and restart Windows when it gets too slow to bear. ✸

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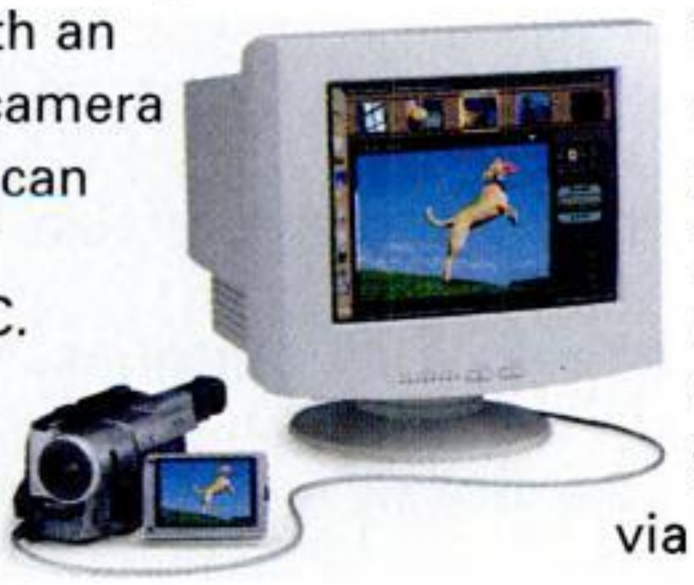

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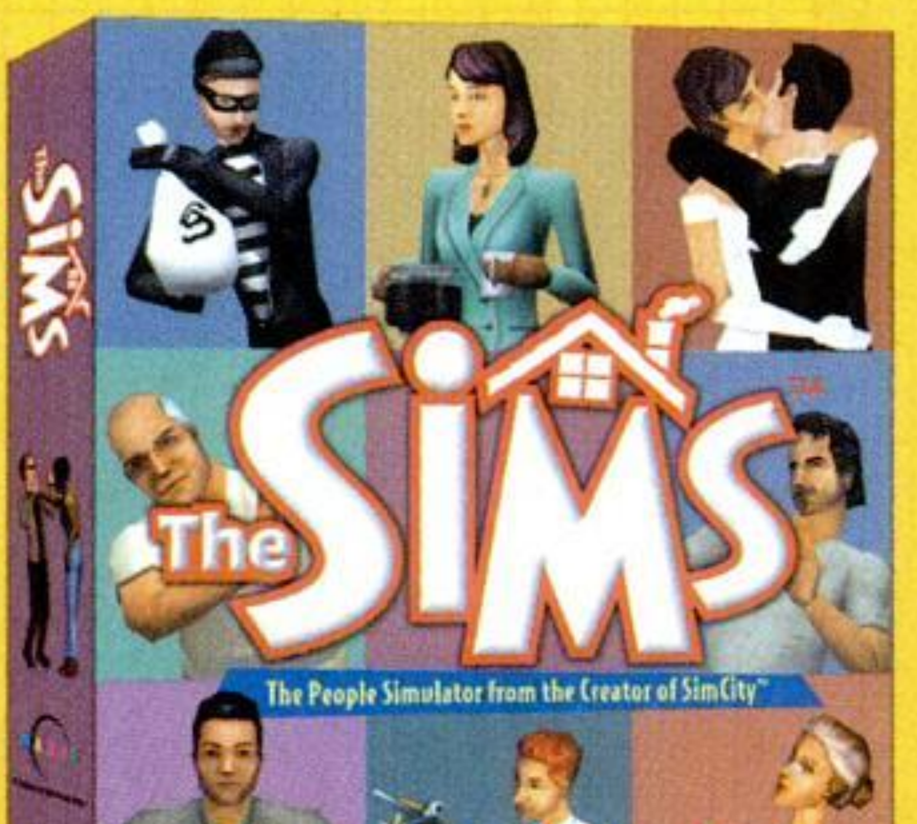
Make sparks fly...



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INTEL STRIKES BACK

1GHz Titans Clash in a Battle of the Benchmarks

intel
pentium III

PHOTOGRAPHY BY AARON LAUER

AMD Athlon
AMD

In *Star Wars* terms, it doesn't look good for AMD. The rebel CPU manufacturer is still relishing its victory high above the planet Yavin, where its new fighter, the Athlon, all but decimated Intel's squadrons of Katmai Pentium III fighters. But it's been six months since that initial Athlon conquest, and now a new Intel Star Destroyer—the 1GHz Coppermine—looms overhead, preparing to unleash canned heat on AMD.

Who wins? In this classic space opera of 1GHz-versus-1GHz power, Intel is the victor. In fact, the 1GHz P-III Coppermine so decisively trounced the 1GHz Athlon in this skirmish, we can almost see Andy Grove looming over Jerry Sanders. Jerry hangs over a ledge with his hand cut off, as Andy reaches out to him and whispers: "Jerry, I am... your father."

The Battle Unfolds

In last month's issue, we reported that both AMD and Intel had announced the release of 1GHz CPUs—but only AMD, via its partner Compaq, could get a 1GHz OEM system into our Lab. This month, we finally had a chance to benchmark a 1GHz P-III machine (from HP), so we set it bough-to-bough against another 1GHz Athlon machine (from Gateway). For kicks, we also compared these two CPU warriors with the Athlons we benchmarked last month.

The single P-III fighter from HP spanked every machine in the Athlon fleet in almost every benchmark. From *SYSmark2000*, to the venerable *bootMark*, to *Quake III*, *Expendable*, *Photoshop*, and *3Dmark2000*, the P-III emerged victorious. That's quite a reversal of fortune since October 1999, when the Athlon made its debut and scattered the Intel CPUs posthaste.

So what happened to the Athlon's lead? After all, in many applications, the Athlon has tested faster than the P-III, all clock speeds being equal. We say the P-III Coppermine's L2 cache made all the difference.

At the time the Athlon was uncloaked, the P-III's 512K of L2 cache sat on an external SRAM chip, and ran at half the core processor speed. But that was back when P-IIIs were still manufactured with the 0.25-micron "Katmai" fabrication process. Today's 1GHz P-IIIs use the 0.18-micron "Coppermine" process, which bumps L2 cache amounts down to 256K, but moves them directly onto the CPU die and cranks them up to *full* core processor speed (so, for example, the onboard cache of a 600MHz P-III will run at 600MHz, rather than the 300MHz it would run at if it were on the SRAM chip).

Continued on Page 58

By Gordon Mah Ung

Gateway Select 1000

INEXPENSIVE—AND IT SHOWS

Gateway's 1GHz system is handcuffed by slow parts.

Though this 1GHz Athlon system from Gateway (**www.gateway.com**) is a reasonably configured package at an affordable price, its benchmark scores were simply too low to garner any enthusiasm from our staff.

Benchmarking began with *SYSmark2000*, which measures performance in a suite of Windows desktop applications. The Gateway posted a score of 165—that's one point lower than an 850MHz Athlon system from Cybermax that we tested but never officially reviewed, and five points lower than the 1GHz Athlon system from Compaq that we reviewed last month. Our next test was *bootMark*, which measures raw CPU integer performance. Gateway's score of 436 is the exact same as the 1GHz Compaq's, which isn't surprising given that both boxes have the same 1GHz CPU with 512K of discrete L2 cache, and both are based on AMD's 750 chipset.

In most other tests, the Gateway's scores were either the same or a tad lower than those of the 850MHz and 1000MHz systems from Cybermax and Compaq, respectively. In *Photoshop*, it was a draw between the three boxes. The same goes for *CDTach* and *MusicMatch Jukebox*. In *HDTach*, however, the Gateway's 24MB/sec average read speed tied our quickly-growing-old zero-point system, and paled in comparison to the 29MB/sec average speed of the Maxtor DiamondMax included in the Compaq system.

The Select 1000's worst performance was in gaming benchmarks, where its SDR GeForce performed on par with the SDR GeForce in our zero-point test system (a 733MHz P-III box). Funny thing is, Gateway now offers only a DDR card with its 1GHz systems, a change made just days after we received the Select 1000. Next time, we'd like the top-of-the-line config.

Rounding out the package are more ho-hum parts, including a 4x4x24 CD-RW, a 10x DVD-ROM from Pioneer (which Gateway has now upgraded to 12x), an unremarkable 19-inch monitor, and Boston Acoustics flat-panel speakers. The speakers certainly look trick, and offer Dolby Digital 4.1 encoding; however, separation between channels was more pronounced than what we've heard with other 4.1 setups.

The other two 1GHz Athlons we've seen incorporate massive heatsink/dual-fan combos to keep the proc on ice. Since this setup was included on both the Compaq and the AMD reference boxes, we figured it was a prerequisite to keeping the 1GHz Athlon chilly. Strangely, Gateway's system comes with the same heatsink/fan combo we've seen on every Athlon *preceding* the 1GHz, and the case moves significantly less air than the configuration of the other two 1GHz boxes. Although we didn't experience any instability issues during testing, the processor emitted noticeably more heat than those in other 1GHz systems.

From top to bottom, the Gateway Select 1000 is a mediocre box. No single component captured our imagination, and the machine's overall performance was lackluster. Nonetheless, it only costs three big ones, making it the least expensive 1GHz Athlon we've seen yet.

—Josh Norem

PLUSES

- Excessive power
- G'Thang graphics card
- 800MHz Athlon
- Striped drives

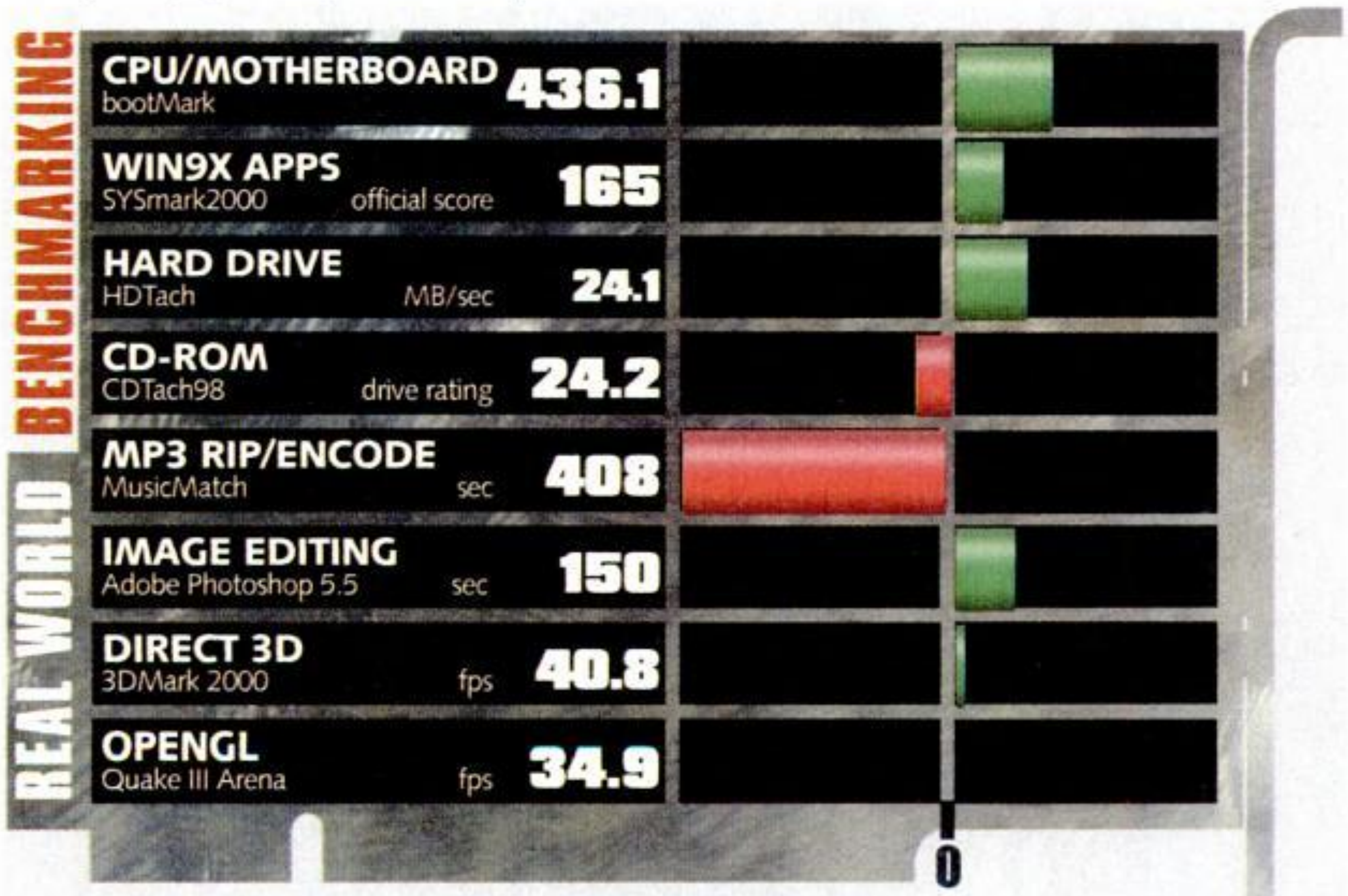
MINUSES

- Round monitor
- No Zip
- Weak speakers

UNDER THE HOOD

THE BRAINS	
CPU	1GHz AMD Athlon
L2 Cache	512K at 333MHz
RAM	128MB PC100 SDRAM (768MB max)
Motherboard	Gateway mobo, AMD 750 chipset
Drive Bays	Three 5.25-inch (one free), four 3.5-inch (two free)
I/O Ports	Two PS/2, three USB, two serial, one parallel
DISPLAY	
Video	nVidia GeForce 32MB SDRAM
Monitor	19-inch VX900 (18-inch viewable, 0.26mm dot pitch)
Refresh@ Max Res	75Hz@1600x1200
STORAGE	
Hard Drive	30GB Quantum Fireball Plus LM
DVD	Pioneer DVD-114 10x
CD-RW	Philips 4x/4x/24x
SOUND	
Sound	Sound Blaster Live! Value
NETWORKING	
56K PCI fax/modem	
THE BUNDLE	
Easy CD Creator 3.5c I Adaptec *DirectCD* I Netscape *Communicator 4.06* I Norton *AntiVirus 2000* I *Phone Tools*	

BOOT **0:53** DOWN **0:02**



See www.maximumpc.com for benchmarking explanations

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EXPANSION NOTES

You've got three PCI slots to play with, and two free DIMMs. We'd hate to have to add a Zip drive or second hard drive though, because the internal wiring is helter skelter.

EXPANSION MAP

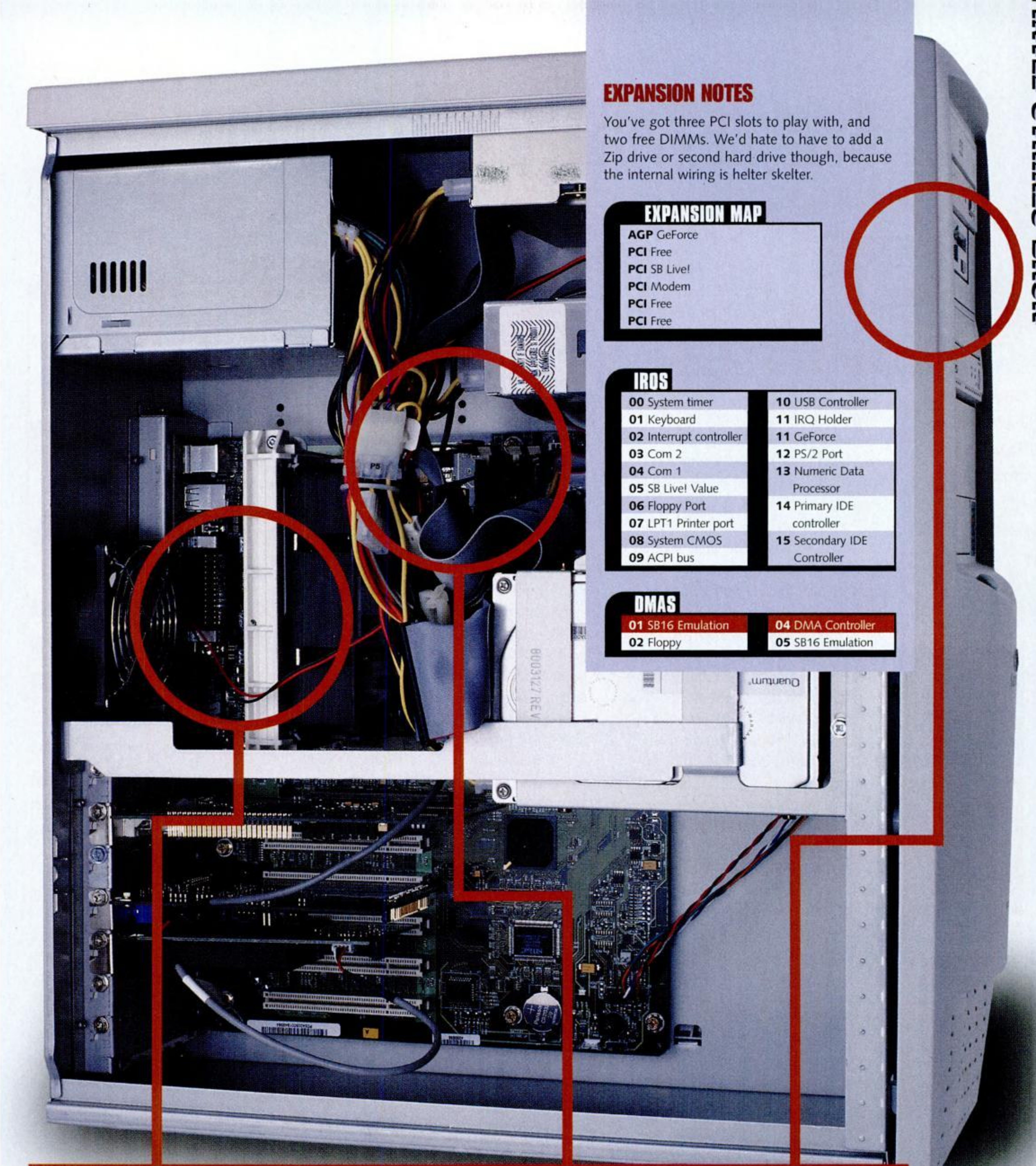
AGP	GeForce
PCI	Free
PCI	SB Live!
PCI	Modem
PCI	Free
PCI	Free

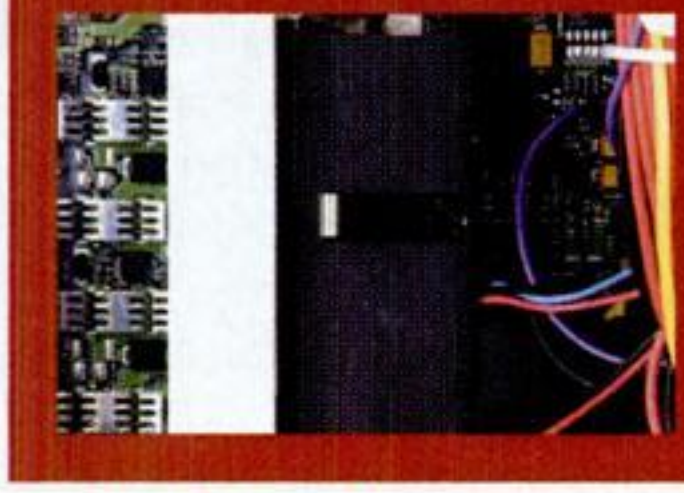
IRQS

00	System timer	**10**	USB Controller
01	Keyboard	**11**	IRQ Holder
02	Interrupt controller	**11**	GeForce
03	Com 2	**12**	PS/2 Port
04	Com 1	**13**	Numeric Data Processor
05	SB Live! Value	**14**	Primary IDE controller
06	Floppy Port	**15**	Secondary IDE Controller
07	LPT1 Printer port		
08	System CMOS		
09	ACPI bus		

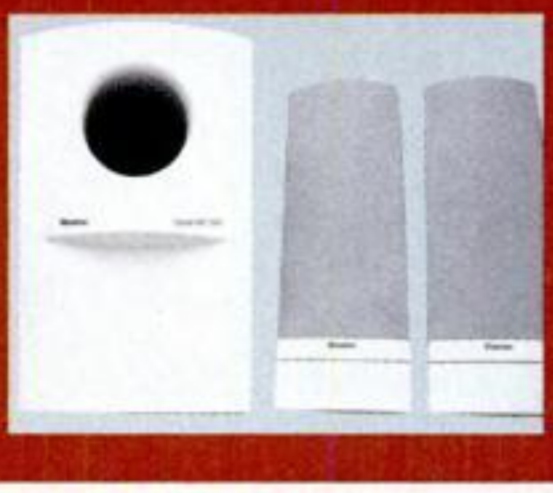
DMAS

01	SB16 Emulation	**04**	DMA Controller
02	Floppy	**05**	SB16 Emulation

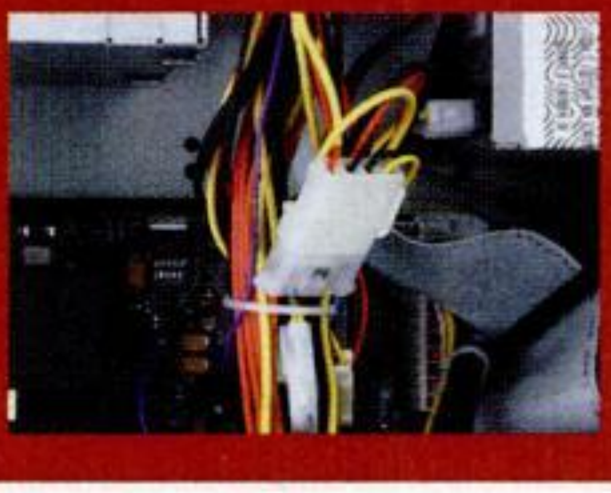




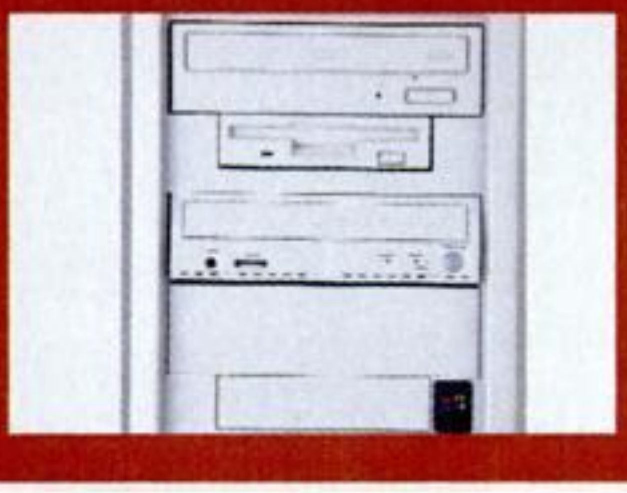
On the hot seat? Gateway's chip has the old-school setup found on slower Athlons: a wee heatsink/fan combo that provides dubious cooling for a proc running at this clock speed.



Flat, but not phat Though the flat-panel Boston Acoustics speakers provided clean-sounding mids and highs, the sweet spot was as small as a cantaloupe.



It's a jungle in there Gateway bundled the power cords, but there's still not much room to move around. And we cut ourselves on the sharp-edged plastic ties.



Drive bays for days Gateway chose a decent ATX tower with seven drive bays. For cooling, the case covering near the processor is perforated, and another fan sits next to the I/O ports.

Hewlett-Packard 1GHz Pavilion

FULL-SPEED CACHE COMES TO THE RESCUE

Hewlett-Packard's Pavilion clobbers Athlon in performance.

HP's 1GHz Pavilion should come with a purple paint job, and a wing towering over its case, because this sucker hauls ass like a gas-guzzling Plymouth from the 70s.

In one decisive swoop, the Pavilion (**www.hp.com**) wiped out almost every Lab benchmark record, including those set last month by AMD's über-1GHz reference box. Unfortunately, HP sacrifices passenger amenities for one fast motor: The monitor is downright cheap, the CD-RW is ancient, and the speakers are about as fancy as an AM radio with large push-buttons.

But the 1GHz Pavilion's secret sauce is, of course, an Intel Pentium III that's been massaged all the way up to 1,000MHz. This P-III, in SECC2/Slot 1 format, runs on a 133MHz frontside bus, care of Intel's "Vancouver" VC820 motherboard. We say "massaged" because the Pavilion's CPU isn't running the standard 1.65 volts that all other Coppermine P-IIIs use—voltage has been nudged up to 1.70 volts for 1GHz. This information caused silicon conspiracy theorists to speculate that Intel had simply overclocked 866MHz P-IIIs to 1GHz to keep pace with the Joneses… er, Sanders.

Intel officials retort that the 1GHz P-III is no patsy, and that the overclocking theories are as nutty as claiming there's a special chipmaking facility called Fab 51. The 1GHz P-III is the real deal and within the spec for Coppermine, Intel officials say. (Besides, we must note that AMD also nudged up voltage when it scaled up to 1GHz.)

Overclocking debates aside, the Pavilion demonstrates the advantages of full-speed L2 cache (the 1GHz Athlon uses one-third-speed L2 cache). In *bootMark*, the Pavilion laid down 486 points—a full 50 points more than the 1GHz Athlon Gateway system reviewed in this feature. In our *Photoshop 5.5* script, the Pavilion hit the finish line almost 20 seconds faster than the 1GHz Athlon Compaq Presario reviewed last month—even though the Presario had twice as much memory. Is Rambus memory finally paying off for Intel? It's possible, but it's also possible that the Pavilion got a boost from *Photoshop 5.5*'s SSE optimizations. The Pavilion system uses PC800 Rambus memory, which itself is about as rare as a 1GHz P-III. Our other tests? In *Quake III*, *Expendable*, *3Dmark2000*, and *SYSmark2000*, the Pavilion pulled away from the Compaq Presario and Gateway Select 1000 as though the Athlon systems had thrown rods.

The 1GHz Pavilion came with the most tricked-out cooling solution we've ever seen on an OEM desktop machine: a gigantic fan mounted on a wind tunnel blowhole. Other amenities in the Pavilion are first rate: Creative Labs Annihilator Pro, Sound Blaster Live! Value soundcard, 40GB Maxtor DiamondMax hard drive, and 100Mb NIC. Though you wouldn't need a hardware decoder, considering the system's CPU and videocard, we would have liked some way to pipe video to a TV.

HP had to cut a few corners to get the 1GHz Pavilion in at a killer $3,500 price. Some will think too many corners are missing, but others will be happy to just be running the fastest desktop PC on earth.

—Gordon Mah Ung

PLUSES

- Record-setting performance
- Big-ass fan
- Phat 40GB hard drive

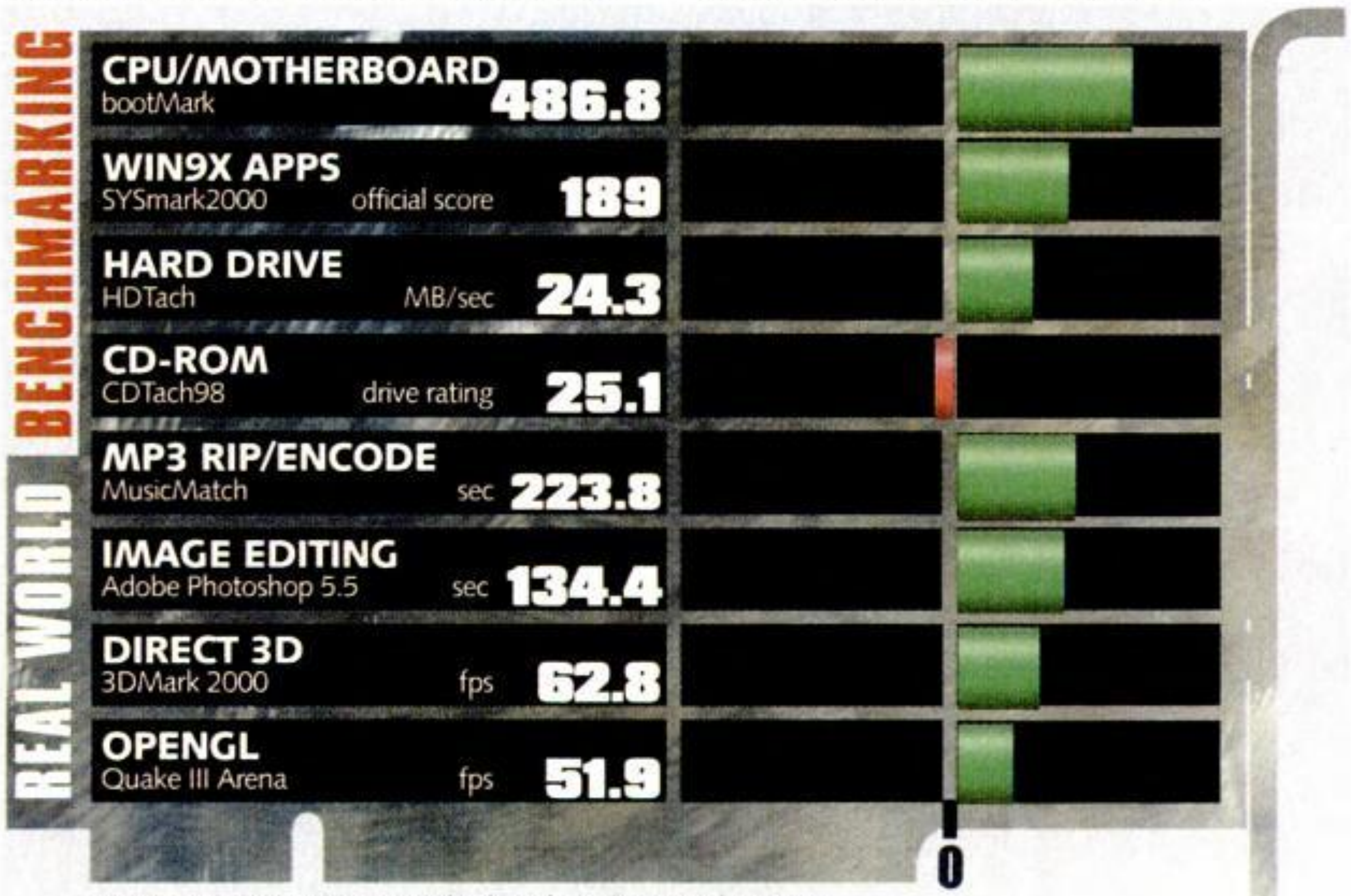
MINUSES

- No TV out
- No quad speakers
- Old-school 4x CD-RW
- Tiny monitor

UNDER THE HOOD

THE BRAINS	
CPU	1GHz Intel Pentium III
L2 Cache	256KB full speed
RAM	128MB Direct RDRAM, PC800
Motherboard	Intel VC820
Drive Bays	Three 5.25-inch bays, four 3.5-inch bays
I/O Ports	One PS/2, three USB, two serial, one parallel
DISPLAY	
Video	32MB Creative Annihilator Pro DDR GeForce 256
Monitor	17-inch Hewlett-Packard
Refresh@ Max Res	85Hz@1280x1024
STORAGE	
Hard Drive	40GB Maxtor DiamondMax 54098U8
DVD	Pioneer DVD-114 10x
CD-RW	Mitsumi CR-4804TE 4x/4x/24x
SOUND	
Sound	Sound Blaster Live! Value
NETWORKING	
Intel Pro/100Mb NIC ǀ Conexant V.90 Data Fax	
THE BUNDLE	
Easy CD Creator 3.5c ǀ Microsoft *Money* ǀ *Works* ǀ *Encarta* ǀ *Quicken Basic 2000* ǀ *QuickLink III Fax* ǀ *Trellix 2.5* ǀ Windows 98SE	

BOOT **0:51** DOWN **0:04**



See www.maximumpc.com for benchmarking explanations

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For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

EXPANSION NOTES

The 1GHz offers a fair amount of drive bays and PCI slots but only has room for another Rambus RIMM.

EXPANSION MAP

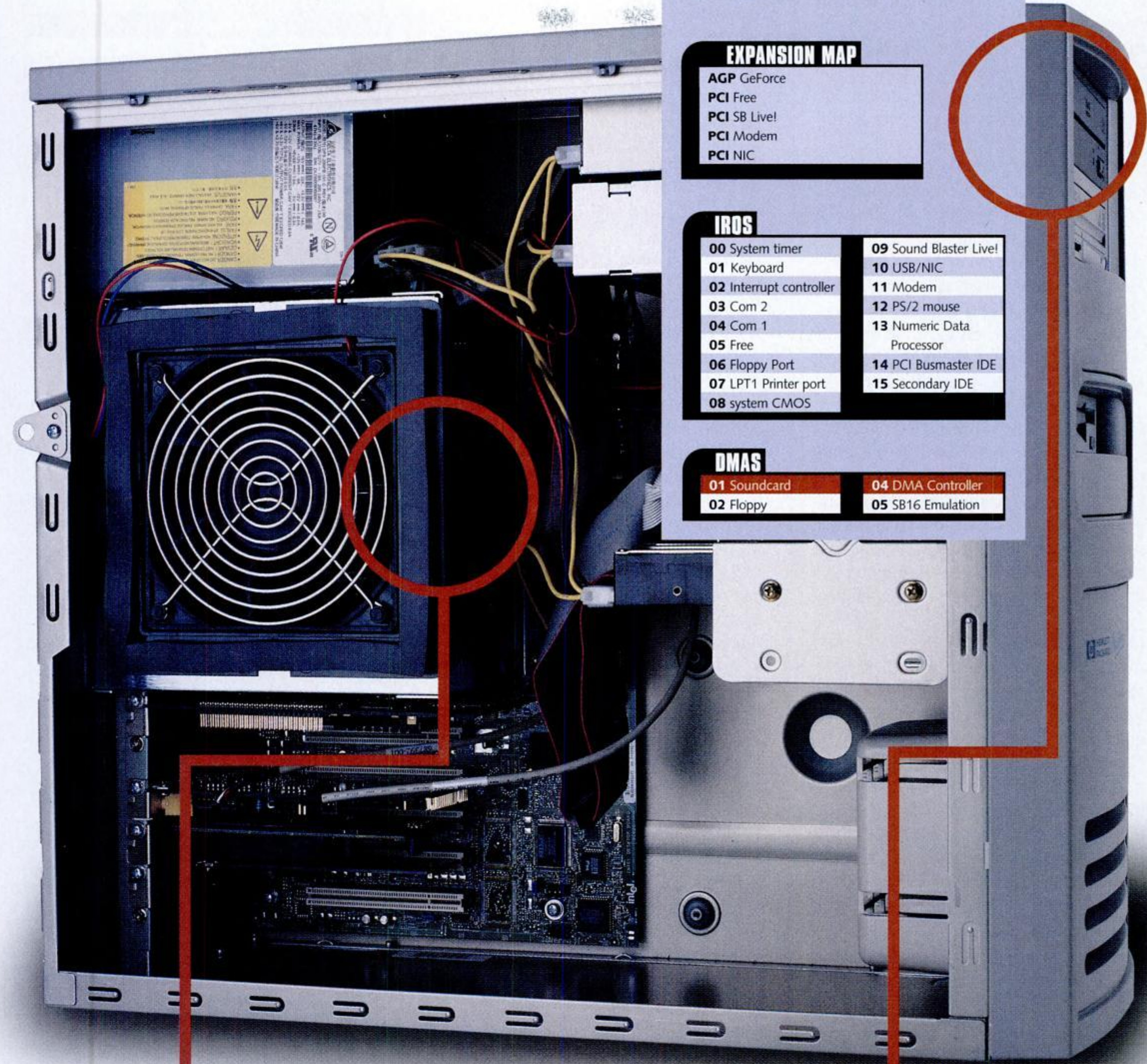
AGP	GeForce
PCI	Free
PCI	SB Live!
PCI	Modem
PCI	NIC

IRQS

00	System timer
01	Keyboard
02	Interrupt controller
03	Com 2
04	Com 1
05	Free
06	Floppy Port
07	LPT1 Printer port
08	system CMOS
09	Sound Blaster Live!
10	USB/NIC
11	Modem
12	PS/2 mouse
13	Numeric Data Processor
14	PCI Busmaster IDE
15	Secondary IDE

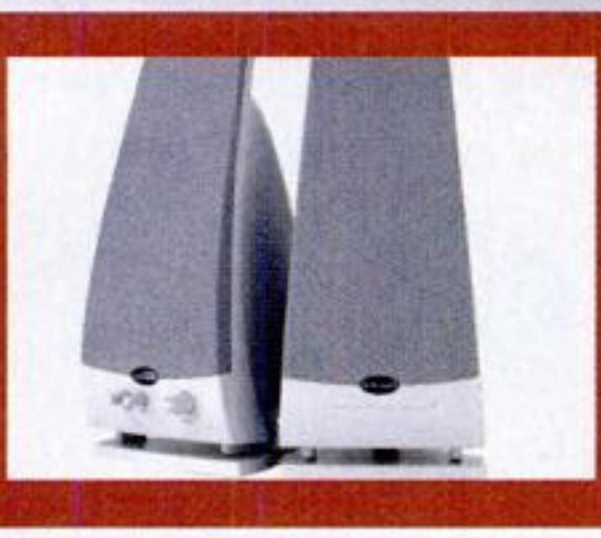
DMAS

01	Soundcard
02	Floppy
04	DMA Controller
05	SB16 Emulation



Is it a CPU or a radiator coil? Underneath this massive fan is the biggest heatsink we've seen from an OEM. Sure, we've seen bigger after-market heatsinks, but this baby takes the cake.

Mopar Air Grabber Similar to the Air Grabber on Plymouth's Superbird muscle car, this brazen forced-air setup keeps the 1GHz downright chilly.



Senator, I've known Klipsch Speakers, and you're no Klipsch speakers There's a reason why these speakers are round: HP had to cut corners somewhere.

Fast CPU, slow burns HP mismatched this build when it paired a pathetic 4x4 CD-RW drive with the fastest CPU it has.

If you recall, L2 cache is the second most-immediate place the CPU looks for data or instructions (refer to page 68 of the March 00 issue for a more in-depth explanation of this process). L2 cache performance can have a profound effect on certain applications, and testing proves that 256K of full-speed cache actually offers greater speed dividends than 512K of half-speed cache.

AMD has not yet adopted on-die L2 cache; current 1GHz Athlons still feature off-die L2 that sits next to the CPU chip on a common daughtercard. Off-die L2 cache is limited by the speed ceiling of industry-approved SRAM, which stops running reliably past 350MHz. For this reason, some Athlons' L2 cache is set to run at half-speed, while others' L2 is set to two-fifths-speed, and still others' is set to one-third-speed.

For example, a 700MHz Athlon's L2 runs at 350MHz, or half-speed. The 800MHz runs its L2 cache at 325MHz, or two-fifths of the overall speed. At 1GHz, the Athlon's L2 cache finds itself running at a leisurely 333MHz, or one-third of the CPU clock speed. Because its L2 is pumping out data slower than a rusty bilge, the Athlon has lost its performance edge to P-III Coppermine.

Fab Constipation

Although we found the 1GHz P-III to be faster than the Athy, we have a strong caveat: Intel's 1GHz CPU is available only in "limited quantities." The company didn't define "limited quantities" for us, but we believe it's not in the hundreds of thousands, or even the tens of thousands. Intel is more likely producing 1GHz P-IIIs by the thousands. If that doesn't sound bad, consider that Intel sells more than 100 million computer chips a year. P-IIIs running at 1GHz aren't expected to be available in volume until Q3 2000. The Athlon's 1GHz yields are much more plentiful. AMD officials say they expect to ship hundreds of thousands of Athlons at greater than 900MHz, and that a "significant portion" of them will be 1GHz.

AMD officials acknowledged that L2 cache limitations hamper the 1GHz Athlon in some benchmarks, but noted that at least the company's 1GHz CPU is available en masse. For this reason, AMD says its price of $1,299 for the only 1GHz processor you can actually buy is justified with respect to the $900 price tag for 1GHz P-IIIs, which you can't buy.

The Specs at a Glance

CPU	ATHLON	PENTIUM III
Speed	1GHz	1GHz
Process Technology	0.18-micron/K75	0.18-micron/Coppermine
L1	128KB full-speed	32KB full-speed
L2	512K/333MHz/off-die	256K/1GHz/on-die
Transistor Count	22 million	28 million
Die Size	102 mm^2	106 mm^2
Core Voltage	1.80 volts	1.70 volts
Wattage	60-65 watts	33 watts
Interface	Slot A (SC242)	Slot 1 (SC242)
Bus Speed	200MHz	100MHz, 133MHz
Memory Speed	100MHz, 133MHz	100MHz, 133MHz
Price	$1,300	$900
Availablity	Good	Limited

Infrastructure Updates

In addition to full-speed L2 cache, the P-III also gets a good assist from Intel's 820 chipset. The 820 features AGP 4x, ATA/66, and a 133MHz frontside bus using Direct RDRAM (or Rambus) memory. In the 1GHz HP machine we review on page 56, HP opted for the ultra-rare PC800 flavor of the RDRAM. Say what you will about Rambus and 820, but in most of our benchmarks, the Intel chipset and its memory du jour meant improved performance—at least in comparison to AMD's 750 chipset and PC100 SDRAM.

Since its introduction, the AMD chipset has had teething pains. First, the chipset can't run at higher than 1x AGP when coupled with nVidia's GeForce 256 boards. The companies are pointing fingers at each other, but in the end, if you plan to pair the fastest gaming videocard with an Athlon and an AMD 750-based motherboard, you'll be running at AGP technology circa 1997. Second, the AMD 750 supports just 100MHz SDRAM. This speed of memory was already getting boring when the Athlon first launched. Today, it's thoroughly disappointing.

The situation improves with VIA Technologies' new KX133 chipset. Basically an Athlon-ready version of its Apollo Pro 133A, the KX133 provides the Athlon with 4x AGP and support for PC133 and VC133 SDRAM memory. In our testing, this appeared to help close the performance gap with the P-III/820.

The Benchmark Numbers

No matter how you view our benchmark results, it's clear that the P-III 1GHz has the edge. For this month's testing, we used one Athlon machine from Compaq and one from Gateway, an AMD Athlon reference box, and a P-III Coppermine machine from HP.

The Gateway machine is hampered by the AMD 750 chipset, just 128MB of PC100 SDRAM, and an SDRAM-based GeForce videocard. The Compaq machine uses the 750 chipset but includes a DDR-based GeForce and 256MB of PC100 SDRAM. The AMD reference box uses the VIA KX133 chipset, a DDR-based GeForce, and 256MB of VC133 memory. Virtual Channel memory features a small amount of super-fast SRAM, and an intelligent controller to route and buffer requests for data from system RAM.

In *SYSmark2000*, the P-III whupped the AMD 750-based Athlon boxes by as much

"But the Athlon is a peaceful CPU! It has no weapons!"

as 24 points. Only the KX133 Athlon scored within striking distance of the P-III in *SYSmark2000*. In the floating-point arena of 3D gaming, the P-III again had the upper hand, besting all three Athlons at all resolutions. At lower resolutions in *Quake III* and *Expendable* (where CPU power has a greater effect on frame rate differences), the P-III posted an even wider performance margin. The full-speed L2 (and perhaps strong SSE support) makes the P-III the winner here.

In *3DMark2000*, the Athlon made a strong stand against the P-III—but only when we toggled on hardware T&L. With T&L enabled, the Athlons' scores improved, while the P-III scores remained relatively stable. Explanation? The P-III already has enough CPU power to reach high scores, while the Athlon can really use an assist from the T&L engine sitting pretty on the GeForce videocard.

The Athlon once again lost in the *Inspire 3D* modeling application, but that's no surprise. AMD has told us that *Inspire*'s code defies all opportunities to execute multiple floating-point instructions in parallel, which would improve scores significantly. The software hooks more readily into the P-III's superscalar architecture. Chalk it up to the idiosyncrasies of software and CPU design, but know this: *Inspire* is the consumer version of Newtek's industrial-strength *LightWave* modeler, and if Athlon exhibits the same weaknesses with *LightWave* and other hardcore, multithreaded modeling apps, it could hamper AMD's move into the workstation market.

We didn't expect the Athlon to cede victory in *Photoshop*, yet both the AMD 750 and KX133 systems got badly burned by the 1Giggy HP. Doh! Just a couple hundred megahertz ago, the Athlon ruled the *Photoshop* kingdom. We blame it on the L2 bugaboo and SSE support in *Photoshop 5.5*. (Note to AMD: Nag Adobe to add 3DNow! support.)

Not all was negative for AMD. The Athlon ruled in the *SiSoft Sandra 2000* synthetic benchmarks, and trumped the P-III in the memory bandwidth test. (Our guess is that even the ultra-expensive PC800 Direct RDRAM memory couldn't whup the Athlons' 200MHz EV6 bus.)

The Next Episode

AMD knows the L2 cache issue is killing the Athlon's performance and will address it with the new Thunderbird core, which is already in the hands of OEMs for testing. Based on the Athlon core, Thunderbird will feature full-speed, on-die L2 cache, and use copper interconnects instead of aluminum. Because copper interconnects offer better conductivity, Thunderbird will be able to support faster clock speeds.

AMD hasn't disclosed how large its new L2 will be, but you can guess it plans to get back in front again. Of course, Intel is no dummy. After losing the race to reach 1GHz (read the skinny in the May 00 issue), Intel knows that the P-III's days could be limited with AMD's Thunderbird on tap. To end this battle once and for all, Intel will introduce its secret weapon, codenamed Willamette. Stay tuned. ◆

The Benchmarking Firefight: Dare to Compare

We gathered together all of the 1GHz systems sitting in our Lab, and pitted them against each other in a three-against-one firefight. **Bold** scores denote victory. As you can see, the Pentium III-powered HP machine summarily fragged each Athlon fighter into oblivion. That's great news for Intel, but doesn't do much for all the consumers who can't find a 1GHz P-III.

MANUFACTURER	REFERENCE	COMPAQ	GATEWAY	HP
CPU	1GHz Athlon 33MHz L2	1GHz Athlon 333MHz L2	1GHz Athlon 333MHz L2	1GHz P-III 1GHz L2
Chipset	VIA KX133	AMD 750	AMD 750	Intel 820
Graphics	GeForce 256 DDR, 3.77 drivers	GeForce 256 DDR, 3.77 drivers	GeForce 256 SDR, 3.79 drivers	GeForce 256 DDR, 3.77 drivers
RAM	256MB VC133 SDRAM	256MB PC100 SDRAM	128MB PC100 SDRAM	128MB PC800 Direct RDRAM
*SYSmark*2000	182	170	165	**189**
bootMark	452.7	436	436	**483**
Quake III 640x480	93.8 fps	92 fps	79.9 fps	**104.0 fps**
Expendable 512x384x16	91.9 fps	87.6 fps	88.2 fps	**98.5 fps**
*3DMark*2000 CPUMark (T&L) enabled)	348	314	317	**402**
*3DMark*2000 3DMark (T&L enabled)	4840	4424	4040	**4949**
*3DMark*2000 CPUMark (T&L disabled)	316	283	284	**404**
*3DMark*2000 3DMark (T&L disabled)	4750	4404	4183	**5444**
Inspire 3D	265 sec	258 sec	260 sec	**208 sec**
Photoshop 5.5	146 sec	154 sec	167 sec	**134.4 sec**
SiSoft Sandra 2000 Dhrystone (MIPS)	**2789**	2779	2777	2690
SiSoft Sandra 2000 Whetstone (MFLOPS)	**1392**	1389	1388	1335
SiSoft Sandra 2000 Stream Memory Bandwidth Integer	**476**	376	378	380
SiSoft Sandra 2000 Stream Floating-Point	**598**	419	413	482

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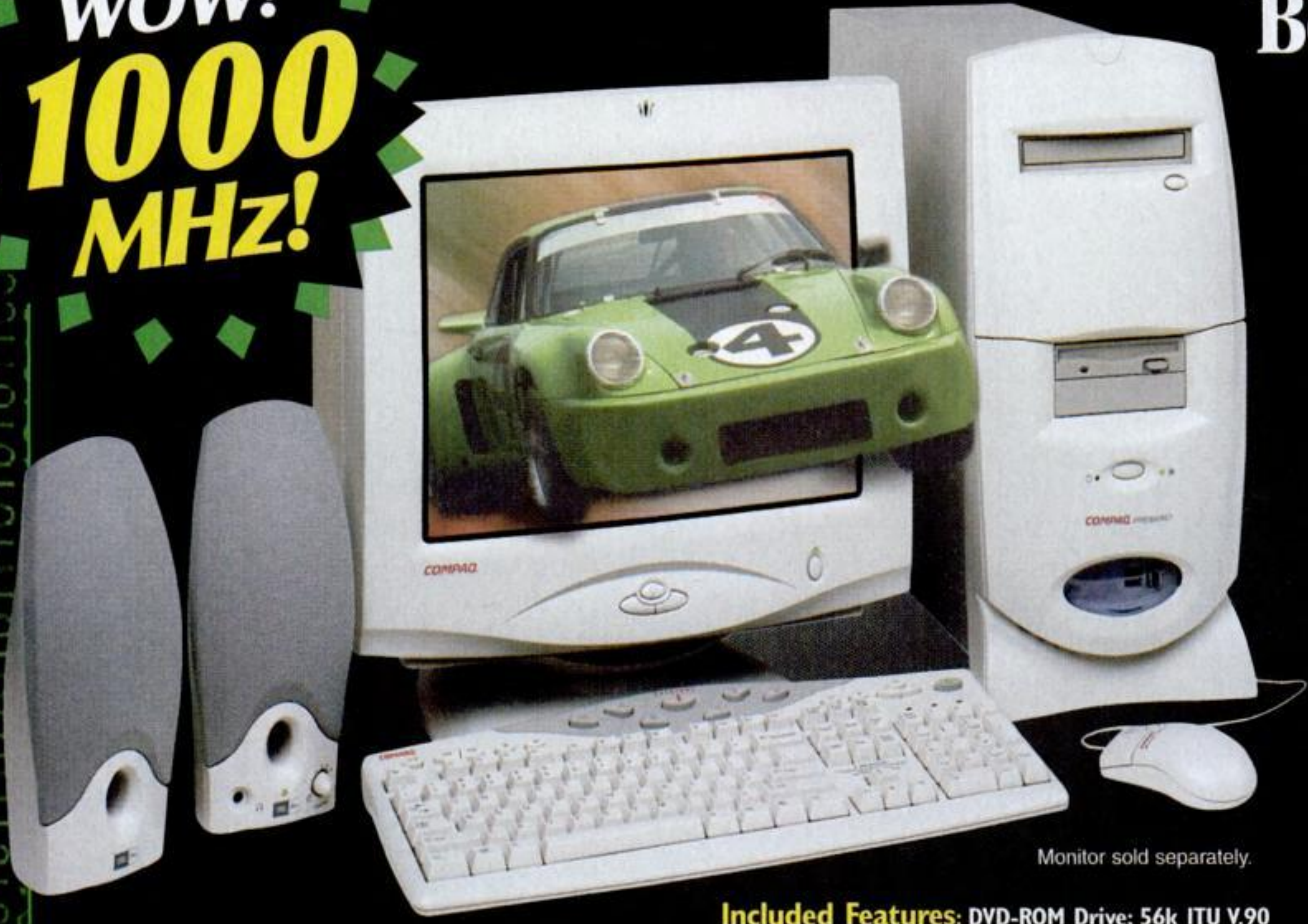

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Included Features: DVD-ROM Drive; 56k ITU V.90 Modem; 128KB integrated L1 Cache; 512KB integrated L2 Pipeline Burst Cache; Compaq Internet Keyboard; Digital Creativity Imaging Center with IEEE-1394; Two front-accessible USB ports; Diamond Stealth III S540 Graphics Card with 165 MB SyncDRAM video memory; MPEG2; 128-bit hardware-accelerated graphics; Sound Blaster 128 Voice PCI Audio with EAX 1.0; 3.5 in. 1.44MB diskette drive; Internet scroll mouse

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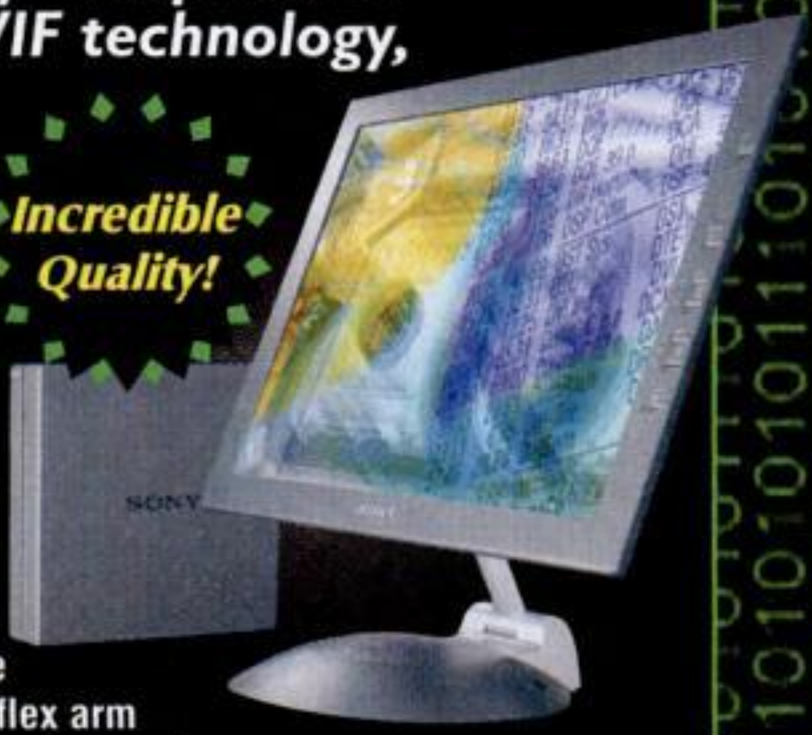

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Sharper Images

The latest digital video cameras turn your home into Hollywood

By Geoffrey Visgilio

The first digital video cameras were fun to use—as any toy should be—but produced results that were, at best, a far cry from *Casablanca* (or even *The Blair Witch Project*). In its original form, digital tape technology was so bulky, DV cameras looked like cinderblocks with lenses. And the poor image quality, rotten motion tracking, lack of special effects and editing options, and outrageous price tags that accompanied them made the early-adoption group a small one.

That was then. This is now. Sleek, shiny, and exceedingly serviceable, the latest digital video cameras demonstrate that technological improvements have turned these weekend toys into high-performance tools.

CCDs—charge-coupled devices, the staple of every DV camera—are now capable of capturing more pixels and delivering better detail. RGB filters, which digitally interpret the fundamental reds, greens, and blues of incoming light, now produce footage with more accurate and vibrant color. IEEE 1394—also known as FireWire—is now an industry-standard means of moving multimedia files between your PC and your DV camera, with data transfer rates of up to 400Mbps. MPEG encoders are now as good as doorstops, since the cameras themselves capture footage in a digital format that's piped into your PC via FireWire (though you'll still need a capture card to convert the footage into an editable format). And best of all, consumer prices have dropped dramatically.

If you're a budding DeMille, get your star ready for her closeup—you no longer need to secure an entire film crew to make your vision into a celluloid reality. Most digital video cameras are now equipped with Steadyshot stabilization that rids your footage of jerks and bumps; 16-bit audio recording that produces clear, accurate audio with little hiss or noise; and a 16:9 aspect ratio recording option that puts widescreen filming within your grasp.

We'll show you the ins, outs, and in-betweens of four of the newest DV cameras available. We'll tell you what each has to offer, and help you decide which is perfect for the kind of filming you're doing. And we'll give you some tips and tricks on using the popular editing app Adobe *Premiere* to give your movies professional polish.

Quiet on the set, please—we're about to begin.

TOOLS FOR THE DIGITAL MAVEN

▶ **DV camera** (with IEEE 1394 port and cable).

▶ **DV capture board** We suggest anything by Pinnacle, particularly the DV-200 board. At $300, it provides an especially efficient codec (the **compressor/decompressor** that converts digital information into more highly compressed digital information) for fast video capture and processing, and a free PCI slot.

▶ **Editing software** We like Adobe *Premiere* and its myriad third-party plugins that provide added effects. But new players on the scene, including Apple's *Final Cut* and Puffin Design's *Commotion*, offer the same essential editing options.

▶ **"After editing" tool**, such as Xing's *MPEG Encoder*. AVI is the format in which your work is editable, but it can chew up a lot of disk space (a minute of DV video can equal upwards of 700MB of AVI). If you plan to put movies on CD or online, *MPEG Encoder* will help you turn your fat AVI clip into an MPEG-1 file that's smaller and viewable by the masses.

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Canon Optura PI MiniDV Cam

Deserving of the ravest reviews

An arbiter of stunning picture quality, and housing more accessories than a Swiss Army knife, the Canon Optura PI (**www.usa.canon.com**) is breathtaking. It's also touted as the first digital camera built specifically to capture both digital video and still images.

A digital camera sees a scene as a series of horizontal resolution lines. Using a process called interlace scanning, most digital video cameras capture two separate fields of lines and lace them together, resulting in blurry action shots and grainy still images. But Canon equipped the Optura with a Progressive Scan CCD (a new, costly feature usually restricted to higher-end studio production cameras), which captures *all* of the incoming pixels in a single pass, resulting in smoother motion footage and superior still-frame capture. Set the Optura to Progressive Scan Movie mode, and the Progressive Scan CCD works with a digital motor drive (similar to a high-speed drive on an SLR camera) to capture 30 frames per second of action-oriented content.

The Optura's Image Stabilization System yielded action shots so smooth, it appeared as though we'd been at the helm of a studio boom cam. You may not feel or see your hands shaking while you're filming zooms or telephoto stills, but you can be sure they are, and that can result in blurry images. Other DV cameras' digital stabilization electronically anticipates shakes and compensates for them, but can't eliminate them entirely. The Optura employs a lens shift prism that compensates for bumps by reacting to light changes before they enter the image sensor, yielding a picture that's as close to stable as you'll get without anchoring the camera to the ground.

We could have watched *The Blair Witch Project* without Dramamine if it had been shot with the Canon Optura PI's Image Stabilization System.

PLUSES

- Amazing quality overall
- Progressive Scanning means more accurate frame capture
- Motion stabilizer provides near-professional results

MINUSES

- Clip-on accessories sap the battery
- Digital zoom ain't so good

The Optura's RGB Primary Color Filter separates incoming light into the three primary colors, achieving near-professional level footage. Lesser cameras perform no such color separation. Stills and action footage shot with the Optura displayed such an accurate reproduction of flesh tones and subtle gradients, our editors were hard-pressed to tell the difference between shots taken with the Optura and those produced by a stand-alone, high-end digital camera.

The Optura suffers from a problem inherent to most digital video cameras: Its optical zoom works well, but once you reach the lens' limit and rely on the digital zoom to "predict" what a zoomed-in image will look like, you're in trouble. The resulting heavy artifacting and major pixelization mean nasty image distortion and grainy film—we suggest you stick with the optical zoom.

Though the camera includes a boom mike and a mountable light, these accessories feed off the main power supply and suck up precious battery life faster than you can yell "action." Pack an extra battery, because you'll want every second of your tour de force to be captured by this outstanding camera.

THE SPECS

OPTICAL ZOOM	12x
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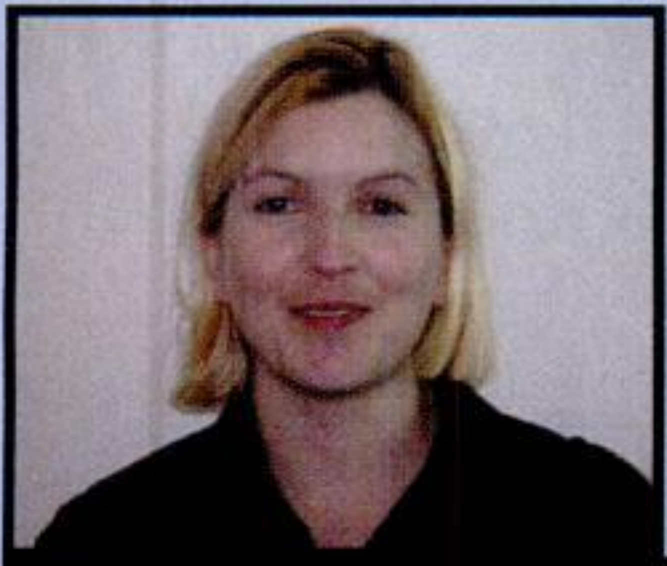
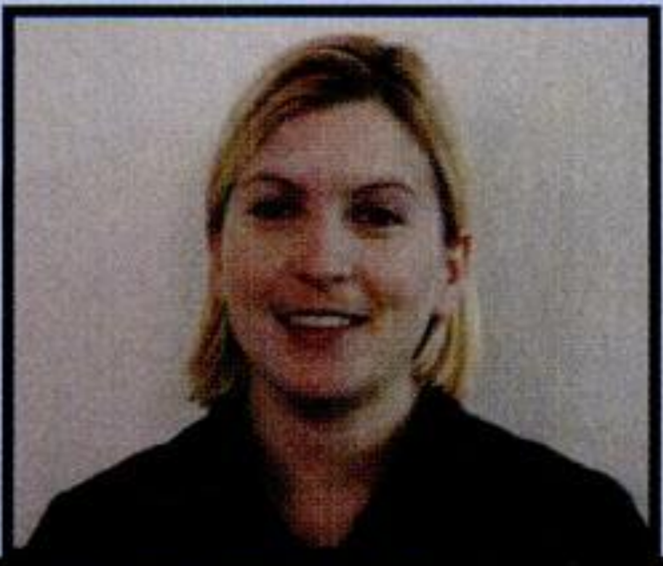
Dare to Compare: Picture Quality



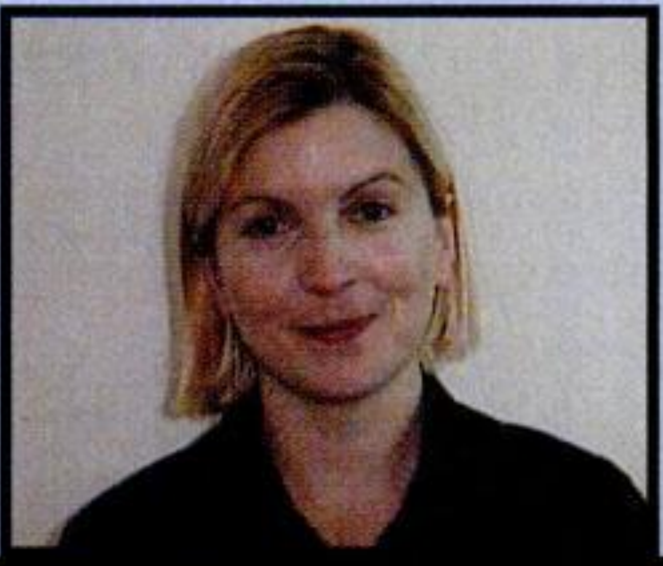
Canon Optura

The stills from the Canon appear to have come from a digital still camera. Aprill's skin tones appear especially accurate.



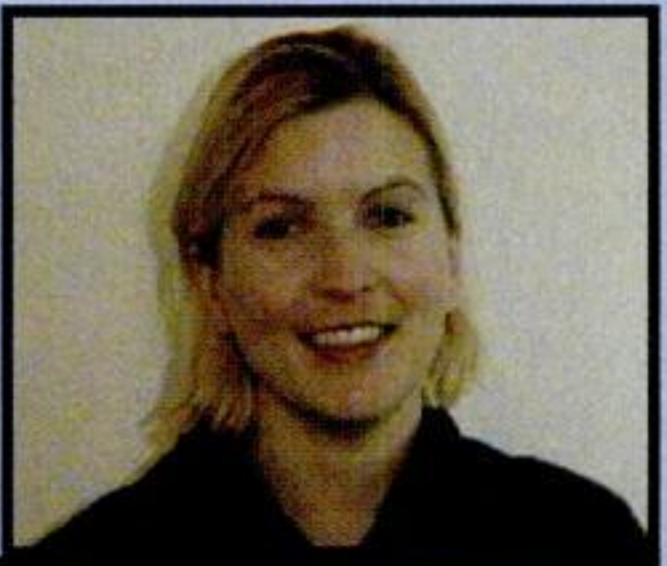
JVC GR-DVL805U

The JVC is a pretty good contender, but suffers a color shift to blue.



Sharp Viewcam

The Sharp produces an image that's not bad, though a little fuzzy and dark.



Panasonic PV-DV100

The Panasonic shouldn't have even included a still shot option—the color is washed out, and Aprill's skin looks jaundiced.

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S3
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DIAMOND
MULTIMEDIA

Add maximum realism to your gaming experience with S3's Diamond Viper II. Tear through high-intensity games and demanding Windows® applications with unrivaled graphics and unprecedented DVD performance. Based on the powerful Savage2000™ processor, Viper II beats the competition with higher frame rates and cutting-edge 3D features including the industry's first QuadTexture™ engine, hardware integrated S3TC™ Texture Compression and acceleration for the newest, coolest software with complete support for OpenGL® and Direct3D®. With 32MB of high-speed memory, TV-out and AGP 4X support, Viper II is a full shot of adrenaline for your interactive gaming. Viper II. Who said anything about playing fair?

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JVC GR-DVL805U Digital Dual Cam

First rate, but still second best

We could have gotten busted for peeping in people's windows with the awesome digital zoom on the JVC GR-DVL805U. It's better than a telescope and perfect for those "artsy stalker" videos.

JVC's GR-DVL805U DV camera (**www.jvc.com**) offers the best damned digital zoom we've ever seen, and excellent picture quality for both video and stills. But its lack of built-in image stabilization and tendency to produce dark images—and we don't mean of the film noir variety—leave it playing second fiddle to the Canon Optura.

In Digital Still Camera (DSC) mode, the GR-DVL805U does an admirable job of making its 250x digital zoom produce better results than the muddy images we're used to seeing from digitally zoomed shots. When the user chooses to take a still shot in "Fine" mode, the camera uses spline interpolation to predict the course of curved lines and smooth out the edges. This alleviates the blocky, pixelated look that plagues most digital-zoom shots. In addition, a picture stabilizer employs motion sensors that adapt to the user's hand-shaking and electronically anticipates reactions, adjusting the camera to ensure that the final shot bears little trace of the wobbles.

As impressed as we were with this camera's digital zoom, we were bowled over by its 10x optical zoom. The ingenious built-in light on the GR-DVL805U's face ensured that lighting photos was never a problem. We shot close-ups of people and parts lying around the Lab (the parts, not the people), and all were reproduced with crisp detail and accurate color, though the results were darker and the colors were less vibrant than those delivered by the Optura.

One of our few problems with the GR-DVL805U is its lack of built-in image stabilization for video—a big no-no. And as useful as the built-in light is, it got very, very hot after just a few minutes of use, and was a major hit on the camera's battery power. The light can be set to come on only in low-light conditions, but once ours went on, we had to manually turn it off.

Our gripes with the GR-DVL805U are more annoyances than serious issues, but we were expecting video full of whiter whites and brighter brights from a camera of this caliber. We understand that Progressive Scanning CCDs are a more expensive option, but once you see that quality, you can't unsee it. After witnessing the Optura do the impossible, we have to rate JVC's digital video offering just below Canon's.

PLUSES

- Spline interpolation makes for great digital zoom
- Optical zoom is pretty kickin', too
- Built-in light

MINUSES

- Light gets really, really hot
- No motion stabilization for video
- Color is darker and muddier than the Optura's

THE SPECS

OPTICAL ZOOM
10x
DIGITAL ZOOM
250x
CCD
1/3-inch 680,000 pixels
LENS
1-inch
TAPES
Mini-DV

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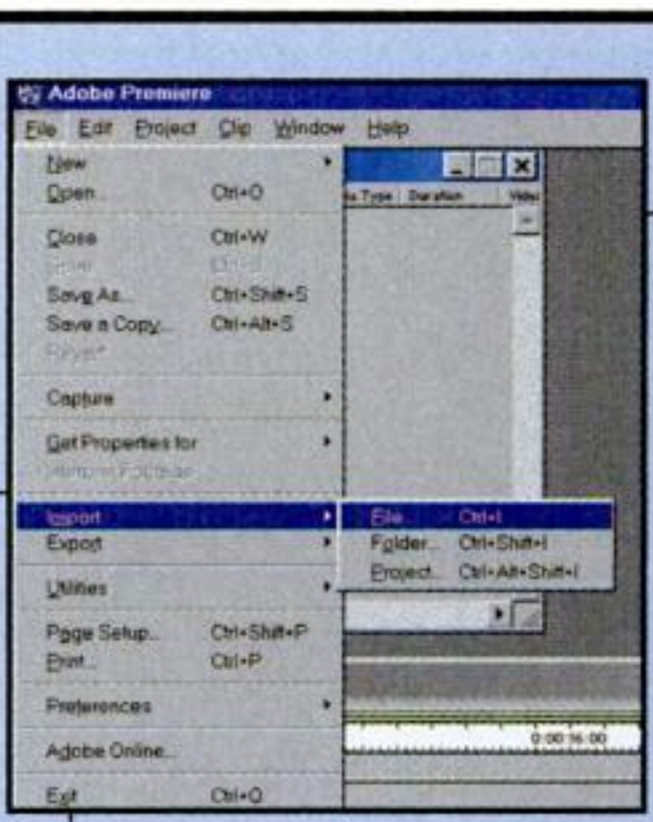
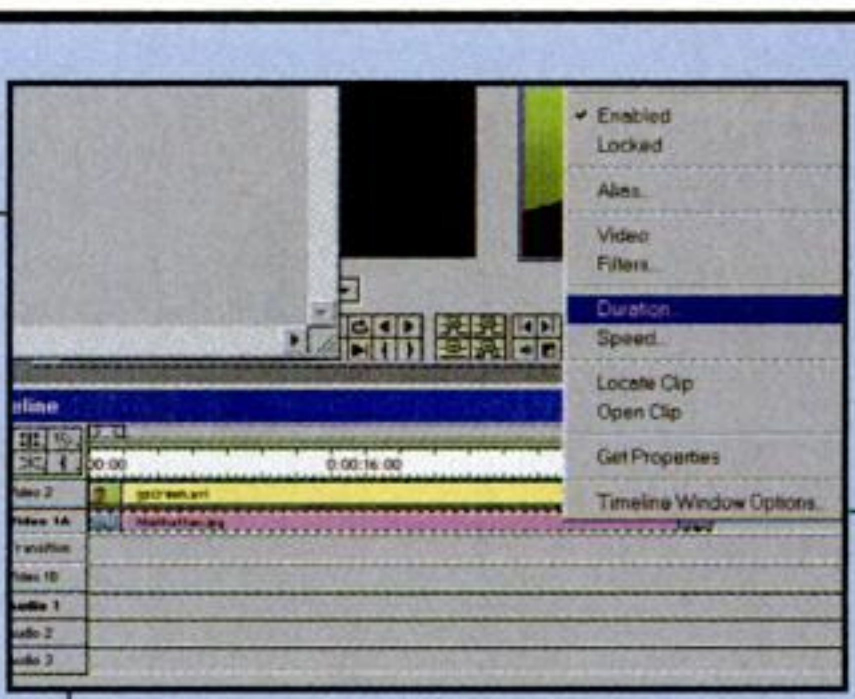
Green-Screening Like the Pros

You've seen it everywhere from your local newscast weather report to *Star Wars*—it's the art of blue-or green-screening, and it's how most film and television special effects are done. Bright blues and greens are colors not found in skin tones, so filming an actor on a blue or green backdrop makes it easy to later edit those colors out and superimpose the actor on a different background. Just procure a blue tarp or some nuclear-green posterboard, and be sure your actor isn't wearing the same color, because those parts will disappear when you edit! You'll also need a still image that will be dropped into the background behind your actor. Save the green-screen footage and the still onto your hard drive, and you're ready to begin the project.



1 Open *Premiere* with the default settings. Import the files you'll be using and drag them onto the timeline, placing the background still in the Video 1 spot and your green-screen footage on Video 2.



2 Your green-screen footage is much longer than your still image—we need to adjust the still-image duration so that it plays for as long as the green-screen footage plays. Right-click your green-screen movie and choose Duration to find out how long the clip is. Now right-click on the still image and choose Duration. Change the duration of this clip to the same value as that of your green-screen clip. On the timeline, you'll see that the two clips are now equal in length.

CONT | 68 ▶

Sharp VL-SD20 Digital Viewcam

Not as sharp as it should be

PLUSES

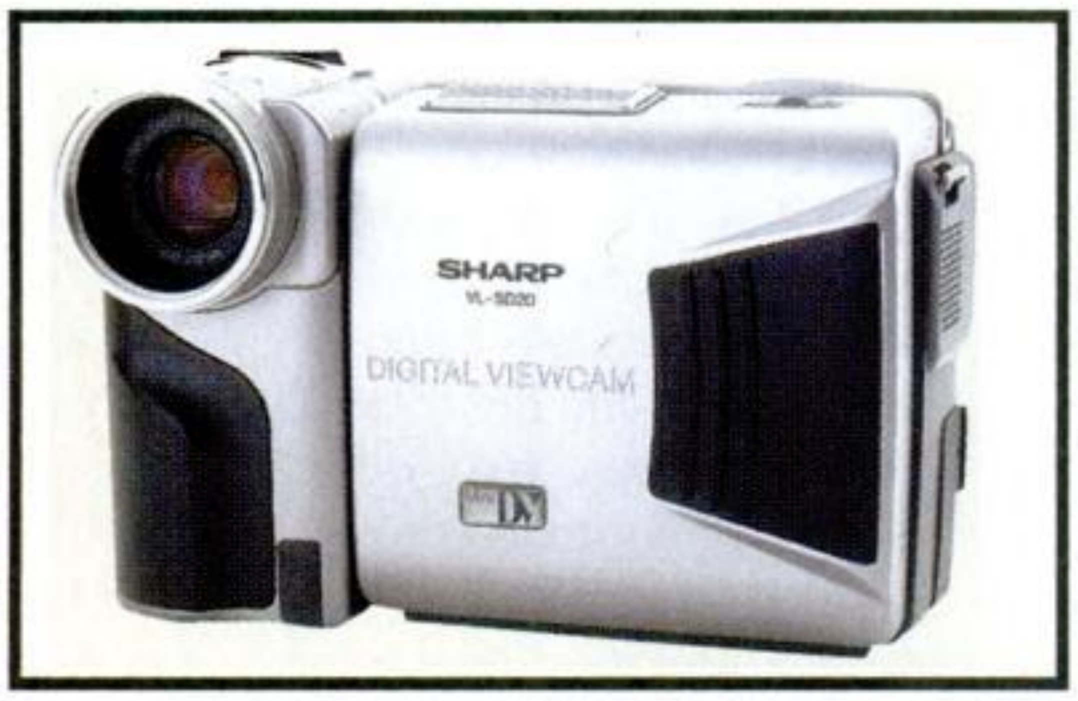
- Ergonomic
- Second-best digital zoom
- Self-recording ability is cool

MINUSES

- No viewfinder
- Bring a tripod to the video shoot
- And a boom mike

THE SPECS

OPTICAL ZOOM	10x
DIGITAL ZOOM	100x
CCD	1/3-inch 660,000 pixels
LENS	1-inch
TAPES	Mini-DV


SHARP
VL-SD20
DIGITAL VIEWCAM
DV

Video shot on the Sharp Viewcam was clear, but far too dark for our tastes.

The Sharp Digital Viewcam (**www.sharp-usa.com**) is the easiest to use of all the camcorders here, but it's frustratingly short on enhancements. Its digital zoom capabilities were almost as good as the JVC's, but it consistently produced dark, shadowy footage, even when scenes were well-lit. Still snapshots suffered the same fate, as though they'd been shot in perpetual dusk.

The Viewcam's LCD display isn't on a hinged door, so you needn't worry about it getting ripped off the camera. The focus controls are intuitive and easy to find, and all recording and playback buttons reside in one localized area. But for all its attractive ergonomic qualities, the Sharp lacks the most integral feature of all: an actual viewfinder. And that's just inexcusable. Granted, those shooting digital video tend to ignore the viewfinder in favor of the LCD screen, but when you're positioning important still or low-light shots, or shooting in bright sunlight where viewing the LCD screen is difficult, that viewfinder becomes invaluable.

A 16:9 aspect ratio setting adds authentic widescreen shooting to your repertoire, but image stabilization goes no further than a small digital enhancement that can handle minor shakes—if stable shooting is a must, you're married to a tripod. As with all the cameras in this roundup, the Viewcam's LCD screen revolves a full 180 degrees, so you can use the remote control to film yourself. But get an external mic if you need to say anything important, because the Viewcam's built-in mic yields a terrible, tinny sound and wind noise, even with the wind filter enabled.

Sharp did equip the Viewcam with a superb battery charging system. Just plug the A/C cord into the Viewcam and it charges—*quickly*. No charger unit needed. This feature is appreciated, along with the camera's user-friendly control layout and comfortable, easy-to-handle design, but these qualities just can't mitigate the fact that the Viewcam lacks features that come standard with most digital video cameras.

SHARP
VOLUME
SHARP

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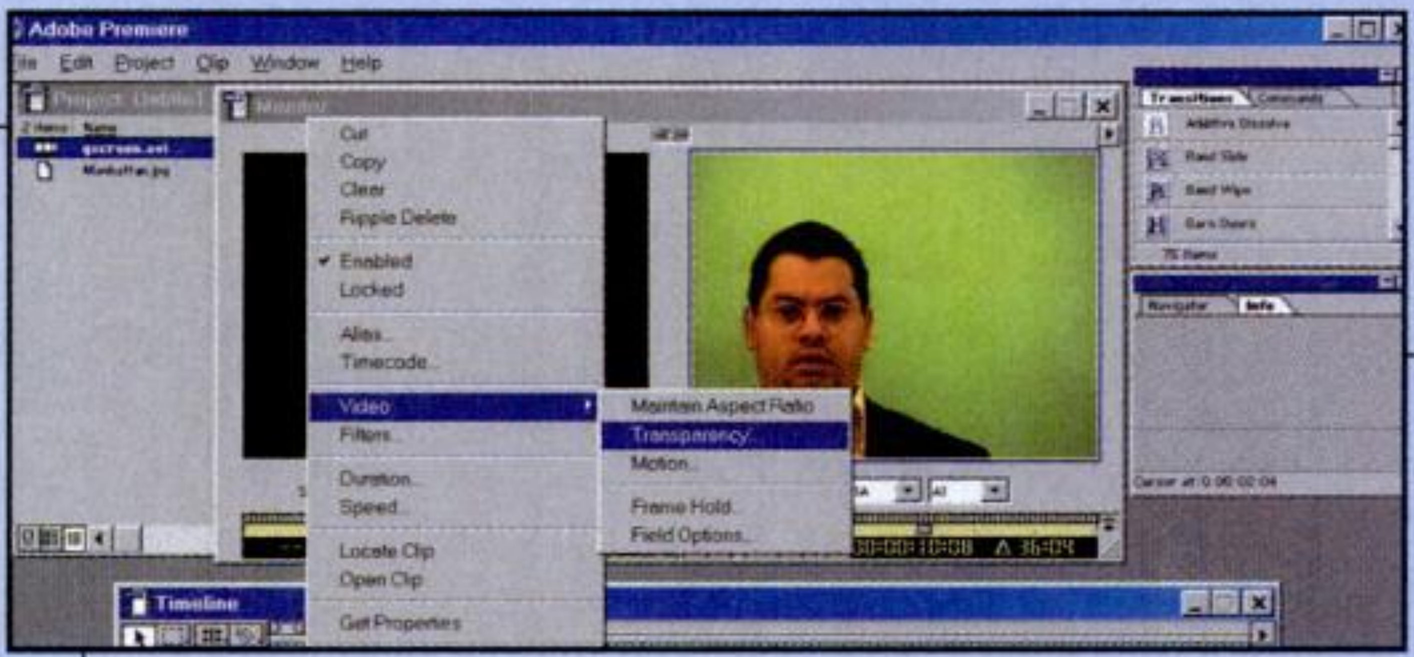
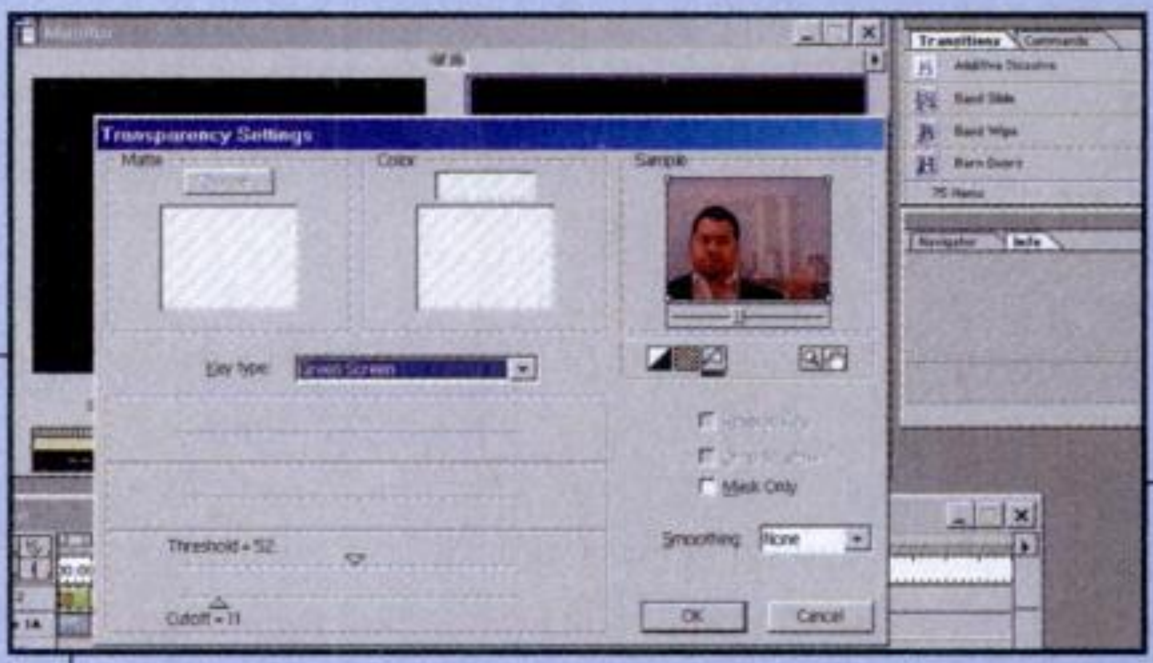

Adobe Premiere
File Edit Project Clip Window Help
Cut
Copy
Clear
Ripple Delete
Enabled
Locked
Alias...
Timecode...
Video
Filters...
Duration...
Speed...
Locate Clip
Open Clip
Get Properties
Maintain Aspect Ratio
Transparency...
Motion...
Frame Hold...
Field Options...
Timeline
Transitions
Commands
Navigator
Info

3 Let's get rid of that neon green, shall we? Right-click on your green-screen clip and select Video/Transparency. A new menu will open, containing a pull-down list of transparency options.


Transparency Settings
Matte
Color
Sample
Mask Only
OK
Cancel
Transitions
Commands
Navigator
Info

Key type: Green Screen
Threshold = 52
Cutoff = 11
Smoothing: None

4 Select Green Screen (or Blue Screen if you went the tarp route). Two sliders, Threshold and Cutoff, will appear. Click on the little black-and-white square, and the green will wash out from behind your subject. Click on the "page turn" symbol to the right of the black-and-white square and your still will appear in place of the green screen. Use the Threshold and Cutoff sliders to fine-tune the brightness and contrast of the background and the foreground, until they look more natural.

Panasonic PV-DV100 Digital Palmcorder

Loaded with features, loaded down with problems

It's under a thousand dollars, but you get what you pay for with the Panasonic PV-DV100.

If this were "The Gong Show," Panasonic's ears would be ringing. The PC-DV100 (**www.panasonic.com**) boasts features common to higher-end cameras and strives to include some real innovations, but it demonstrated the poorest image quality, worst image stabilization, and lowest-quality digital zoom we've ever seen in a DV camera. Gene, Gene, the Dancing Machine would be wearing holes in his soles.

Image quality of both still shots and video produced by the PC-DV100 was grainy and dark. Indoor shooting under fluorescent lighting—the most demanding test of a DV camera, because fluctuating light waves move so quickly that they wreak havoc on a CCD's light-processing abilities—yielded atrocious video, even with compensation filters enabled. The PC-DV100's image stabilization system is unspeakably poor, especially when digital zoom is enabled; zooms shot from a moving car jumped all over the place like a bad MTV video. And what good is a 300x digital zoom? It produces a resolution so filled with artifacts, a picture drawn with crayons would probably be more pleasing. The PC-DV100's case is also blocky and uncomfortable to work with, and the viewfinder—which displays only in black and white—feels cheap and flimsy, and juts out awkwardly from the unit.

In spite of its poor implementation of the basics, Panasonic did attempt to introduce a few interesting features. The Pulse Code Modulation (PCM) sound device offers two channels of stereo sound in 12-bit mode and a single stereo channel in 16-bit mode, so you can thread a voiceover narration or soundtrack into your production by piping it right into the camera. A few unusual editing features enable you to tweak footage before sending it through the capture card. And a VCR mode feature, called Blank Tape Find, sends you directly to the next available blank spot on a tape, eliminating concerns about recording over footage you've already taped.

The PC-DV100 offers six playback viewingspeeds, and frame-by-frame advance for precise frame capture. But these features do little to make up for the camera's overall appalling performance. We suggest you shell out the extra hundred bucks for a Sharp.

PLUSES

- PCM stereo should be standardized
- Blank-tape finder and frame-by-frame advance

MINUSES

- Image stabilization is laughably bad
- Black-and-white viewfinder
- Blocky, bulky, uncomfortable design
- Worst digital zoom of the pack

THE SPECS

OPTICAL ZOOM	18x
DIGITAL ZOOM	300x
CCD	1/4-inch 460,000 pixels
LENS	1-inch
TAPES	Mini-DV

MAXIMUM PC VERDICT 4

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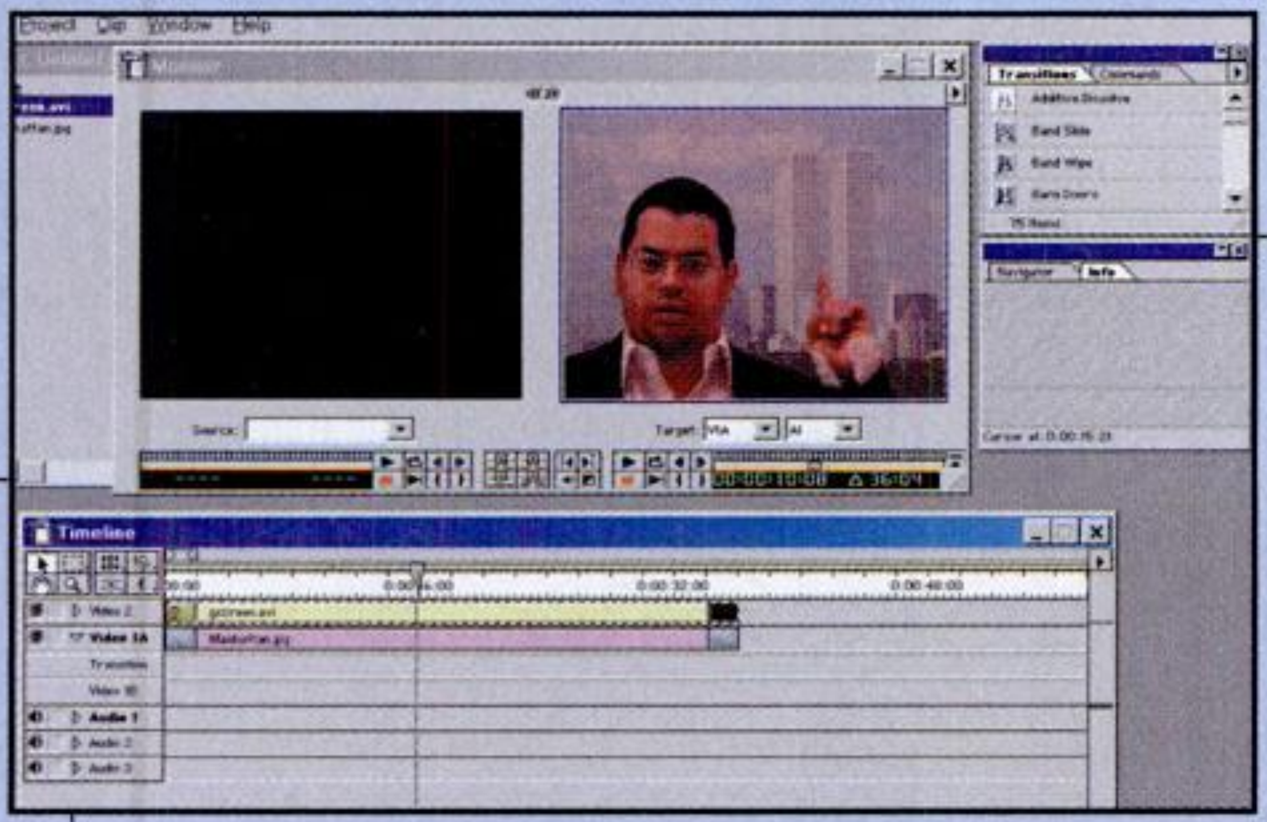
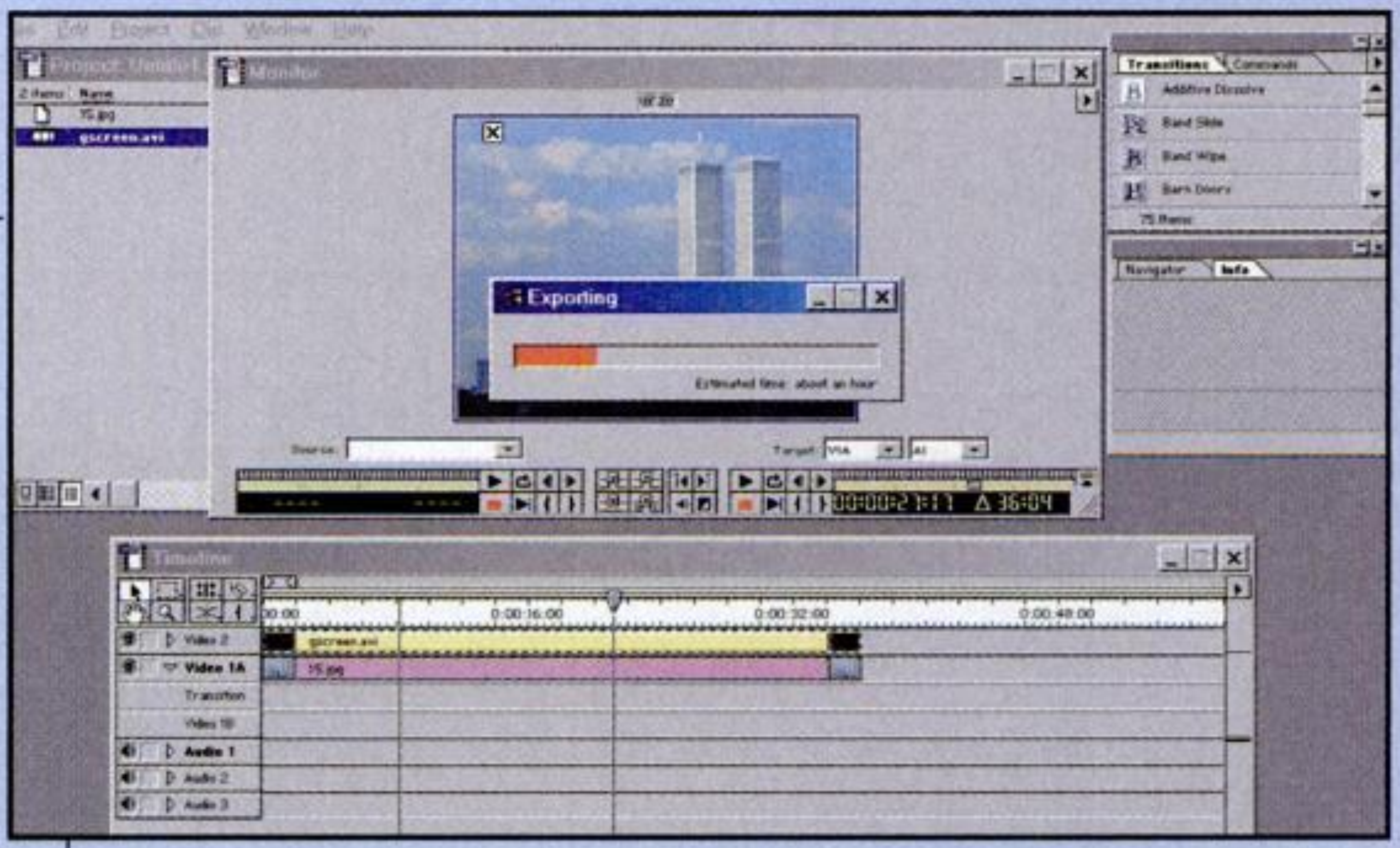


5 When your director's eye is satisfied, click OK. You'll return to the timeline. Hold down the Alt key and drag the slider across the timeline to see the new background. Here is where you can add an audio commentary to Audio 1 or a soundtrack to enhance your finished product. You can also play with filters to create a more realistic effect.



6 Ready for the final cut? Go to File/Export/Movie and click. Title your masterpiece, and go to the Settings tab to adjust codecs and final export settings. When you've finished tweaking, save your work and make yourself a sandwich while you wait for the video to crunch. When you're comfortable with greenscreening, you can add another movie to the background instead of a still, and experiment with more of *Premiere's* filters and lighting effects.

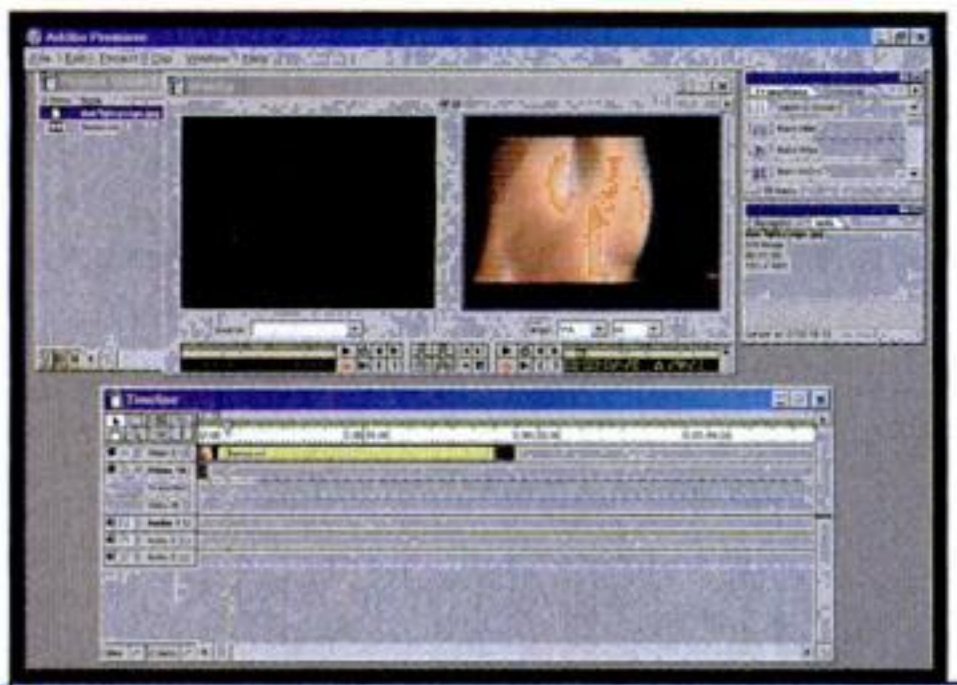
Tips

So you've got the credit card out and you're already writing up contracts for the stars who'll be appearing in your major motion picture. But before you run off into the Technicolor sunset, consider these words of wisdom:

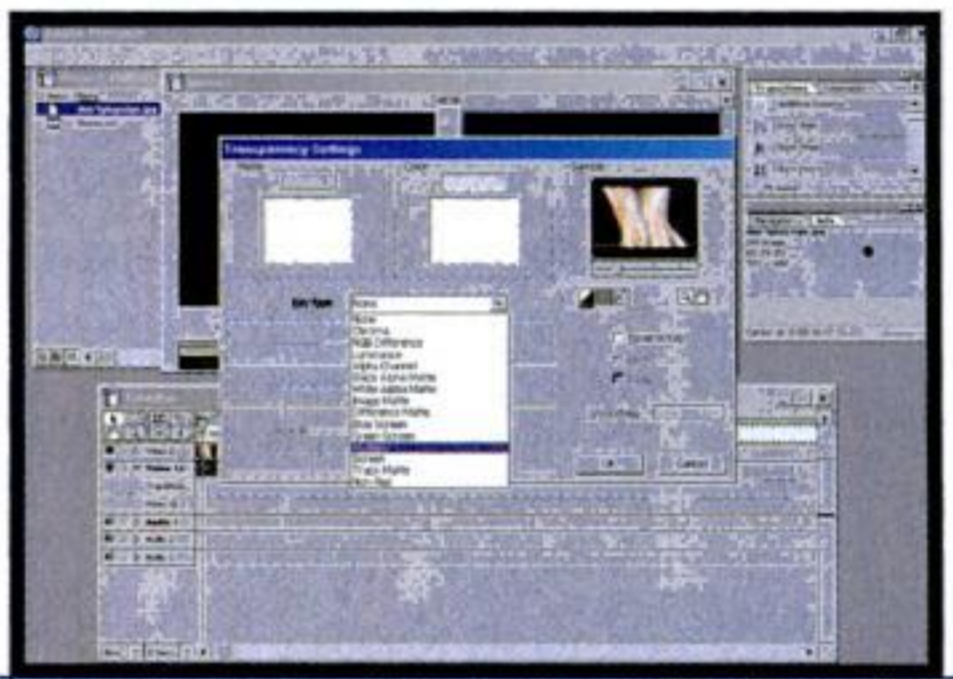
- As good as 16-bit audio gets, don't leave home without a boom or an external mic. Many digital video camcorders, such as the Kick Ass Canon Optura, include an external mic as an accessory, which is great for indoor filming. Outdoor scenes will always sound better when you film first and add audio later—bad video can be fixed, but bad audio will haunt your project forever.
- Cameras such as the Panasonic let you add soundtracks right to your tape before you send it to your computer. This is fine if you're not big on real studio production. But if you want your work to be professional, always add important audio in the software editing phase. You can use *Premiere* to fade in and control audio on multiple channels, and a program such as Sonic Foundry's *Sound Forge* is great for sound effects and voice-echoes or pitch changes during voiceovers.
- There's a reason that the phrase "Let there be light" is so oft-quoted. No matter how many light enhancement filters your camera has, there is no substitute for light in abundance, especially when shooting indoors. Do what the photographers do and carry a spotlight with you.
- Nothing is as steady as a tripod. Motion stabilization has come a long way, but it will never take the place of the physical grounding that a tripod provides, especially if you do a lot of telephoto work. You say you want motion shots *and* stability? Here's an old but effective trick that will work every time: Fasten your camera and tripod to an office chair with wheels. Instant Steadycam.
- If you're dead-set on getting your movie onto the big screen, have it converted professionally. There are post-production houses that will convert your DV to film for anywhere from a few hundred to a few thousand dollars, depending on the length and type of film you want. The money you shell out is worth saving yourself the plunge into madness that you will surely take if you attempt to do it yourself.

Making a Matte for Titles

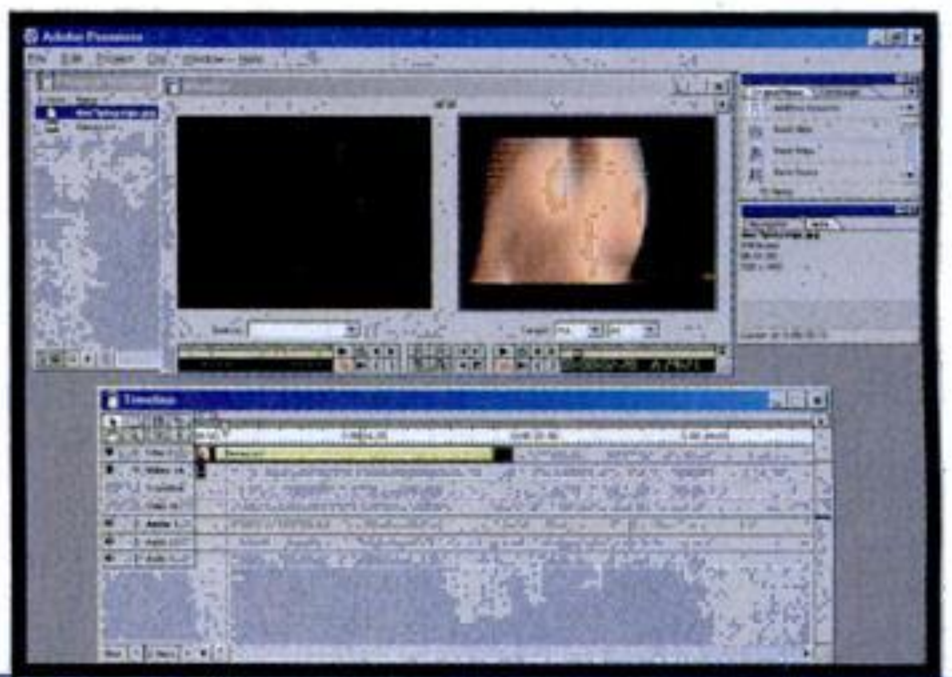
You've seen those movie trailers in which flames lick the edges of the movie title—it's very cool and it stinks of big-budget effects. This tutorial leaves a lot of room for experimentation, and there are worlds of special effects opportunities here for the budding director. While we're not suggesting that you burn the house down, you will need some footage of fire—a tight shot on a candle or a fireplace should suffice. You'll also need a still of your title, or whatever text you'll be setting aflame. Though you can make this still in *Premiere*, its title options are somewhat limited, so we suggest you opt for *Illustrator* or *Photoshop*. Save your video and still on your PC's hard drive.



1 Open *Premiere* with the default settings and import your flame movie and your sign onto the timeline, placing the still image on the Video 1 line and the flame footage on the Video 2 line. You have a creative decision to make here—we went with white writing on a black background so it will appear as though the flames are illuminating the white words. You can go with black words on a white background if you want a more sinister looking title. Remember to adjust the Duration of the still clip to match the length of your flame footage.



2 Right-click on your flame footage and select Video/Transparency. A new window will open, containing a pulldown list of transparency options. Select Multiply from menu. Use the page-turn tab to see how the flames move around your sign. If you like what you see, click OK.



3 Hold down the Alt key and scrub across the timeline to see how your flame effect looks. You can change the color or the speed of the flames, make another movie clip or animation play above or behind your text, or both. You can also bring in Motion Path, to add some depth to your work. When your final cut is finished, hit the Export/Movie tab in the File menu.

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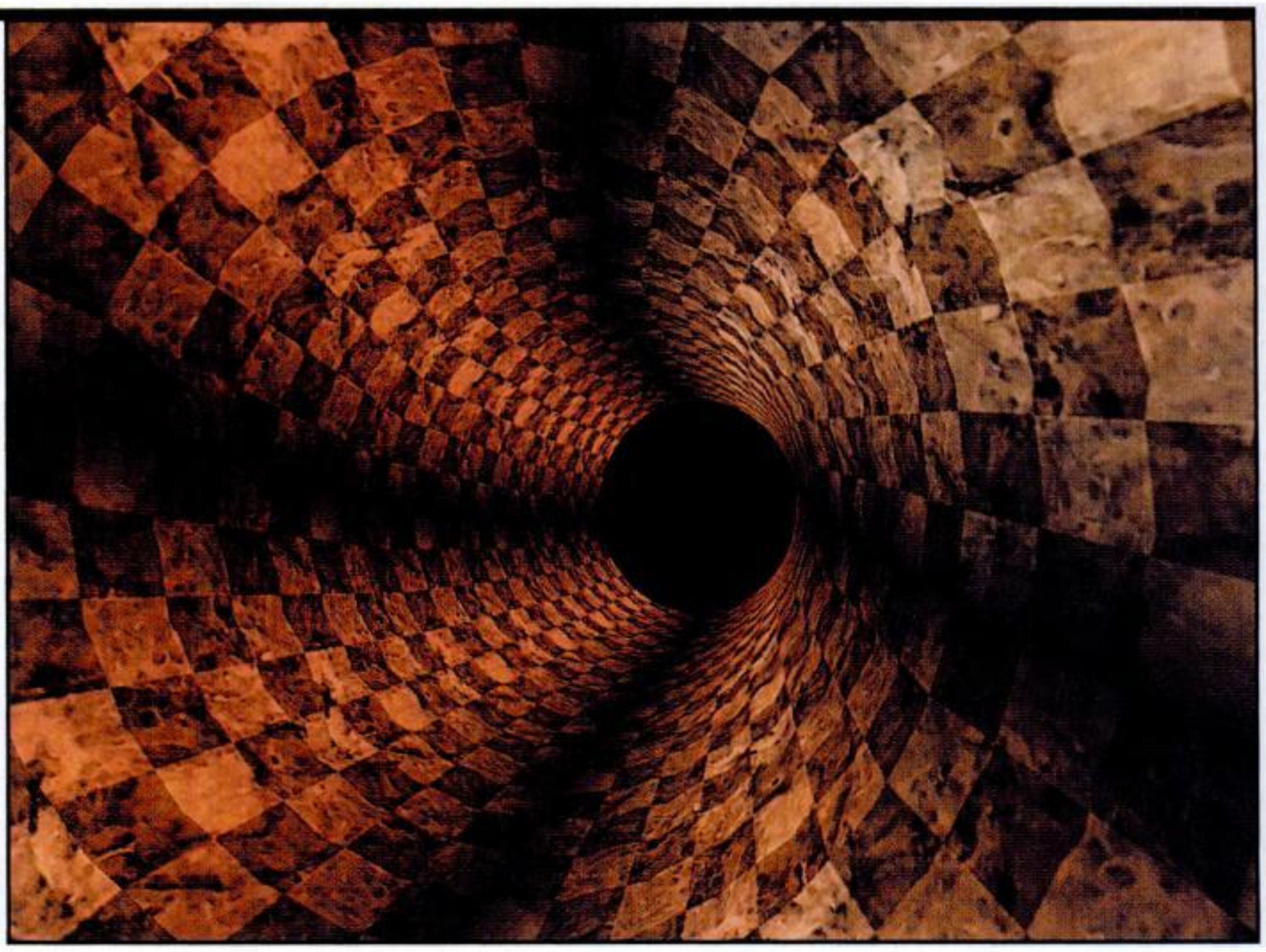
AGP vs. PCI Showdown

Do you really need an AGP card? The truth hurts...

AGP promised more bandwidth for faster frame rates and more realistic games, but as CPUs hit gigahertz clock speeds and graphics processors serve up gigatexel fill rates, how much of this abundant data processing power is making its way across the AGP bus? No game or application currently available actually moves enough data to truly take advantage of AGP, making it difficult to understand why an accelerated graphics port is even necessary. We threw everything we could at the AGP bus, but found that even *Quake III*, the most graphically intense game available, barely moves enough data to make it lift a finger. So why does everyone keep saying that AGP is about to become more vital than ever?

—*Sean Downey*



***3DMark2000's* texture test lumps as many 256x256 textures as needed to make a 32MB tunnel that will choke any videocard that can't texture across the AGP or PCI bus.**

When it was introduced in the fall of 1997, the Accelerated Graphics Port was Intel's solution to the potential data bottleneck holding back 3D graphics on the PC. Enhanced graphical realism requires serious amounts of polygon and texture data to be fed to the graphics processor; the concern was that this data would eventually bump into the ceiling imposed by the PCI bus. At the time, PCI videocards were forced to share 133MB/sec maximum throughput with all the other PCI devices in a system, such as SCSI and network cards. AGP offered a faster, more direct connection to the core-logic chipset, thereby rescuing videocards that had been shackled to the 33MHz PCI bus.

AGP's original incarnation, AGP 1x, had a bus frequency of 66MHz, double that of PCI's frequency. By offering a larger pipe, AGP ideally provides a way of transferring tons of data to the videocard—not only lots and lots of polygons, but also very fast texture downloads. With 264MB/sec throughput, AGP 1x didn't offer any of the advanced features that are associated with today's AGP, such as sidebanding, fast writes, and texturing out of system memory. Those features came along with AGP 2.0, which also sped things up by enabling multiple data transfers on the same clock cycle. With AGP 2x, two 32-bit transfers could be sent each clock cycle, for 528MB/sec throughput. Late last year, AGP 4x doubled AGP2x's transfer rate to four 32-bit transfers per clock cycle, yielding over 1GB/sec throughput.

Along with AGP 2.0, Intel introduced straight pipeline access to system memory for videocards. The idea was that AGP videocards would pull portions of textures from system memory directly into the graphics processor, using local memory for texture memory management. Unfortunately, the speed of texturing across the AGP bus doesn't hold a candle to the bandwidth available from local videocard memory. Few games today rely on AGP texturing for storing and queuing up textures in system memory—they only do it when they have to—since the performance penalties are too great. The local memory bandwidth on videocards ranges from the Voodoo3's 2.9GB/sec to GeForce 2's 5.2GB/sec—a far cry from AGP's paltry 1GB/sec. And texturing into system memory isn't cacheable, so writing across the bus is essentially a non-recoverable action—it takes another extremely slow read to get that data back.

Nevertheless, AGP texturing is the most obvious place to start when measuring AGP bandwidth, simply because it's easy to make some games (*Quake III*, for example) hit the limits of local memory space and spill across to system memory. In most cases, all you need to do is jack up the color depth and set the resolution as high as it can go.

Before doing this with *Quake III*, we decided to test AGP texturing by running a synthetic texturing test from Mad Onion's *3DMark2000* on both a TNT2 AGP 2x and PCI card. Both TNT2 cards ran at the same clock speeds and had the same 32MB of SDRAM; the only difference was in their bus interfaces. With this synthetic test, we hoped to isolate the particular resolution and color depth that would best illustrate where AGP texturing would show a clear advantage over the local memory of a PCI card.

3DMark's texture test forces the videocard to render a tunnel that's

DARE TO COMPARE

NVIDIA TNT2

3DMARK 2000	AGP	PCI
1280x1024 32-bit color	29fps	27.7fps
1600x1200 32-bit color	19.8fps	1.3fps

mapped with 32-bit textures. The number of textures varies according to how many MB you want to throw at the card. In the 32MB texture test, *3DMark2000* feeds 96 256x256 pixel textures down the videocard's throat. When we ran the 16MB test, the PCI card scored the same as the AGP card. At lower resolutions, the TNT2 can manipulate this much texture data in the 32MB of local memory, but when the resolution hits 1600x1200, there just isn't enough space to hold everything. We were actually amazed that the TNT2 PCI card could hold as much as it did. Loading the card up with 32MB of textures should have filled it to the point where it couldn't run a higher resolution than 640x480. Unlike their AGP-based brethren, PCI cards aren't supposed to be able to handle more data than what they can fit in local memory.

Undaunted, we loaded up *Quake III*. Still determined to distinguish between the AGP and TNT2 PCI cards, we loaded up the most brutal timedemo we could find—the Quaver demo created by Anthony Tan (**www.voodooextreme.com/reverend**). Quaver takes place in Q3DM9, otherwise known as the level that makes your PC crawl. With geometry and texture detail set to high, the Quaver timedemo averages nine million texels per frame.

DARE TO COMPARE

QUAKE III (QUAVER)	AGP	PCI
1280x1024 32-bit color	7.2fps	4.3fps
1024x768 32-bit color	15.4 fps	11.5fps
800x600 32-bit color	27.7fps	25.9fps
640x480 32-bit color	48.1fps	42.2fps

Surprisingly, the PCI card never fell too far off the mark set by the AGP card. A quick phone call to the engineers at nVidia clued us in to a little trick they pull with their PCI cards: Essentially, the TNT2 PCI board has almost the same feature set as the AGP version, when it comes to texturing. They've figured out a way to DMA across the PCI bus, allowing texturing tricks that aren't typical of a PCI videocard (if you've been wondering what that PCI texturing slider is for in your drivers, now you know). Since the TNT2 PCI card can do virtual texturing in system memory, we never saw a big fall from AGP to PCI.

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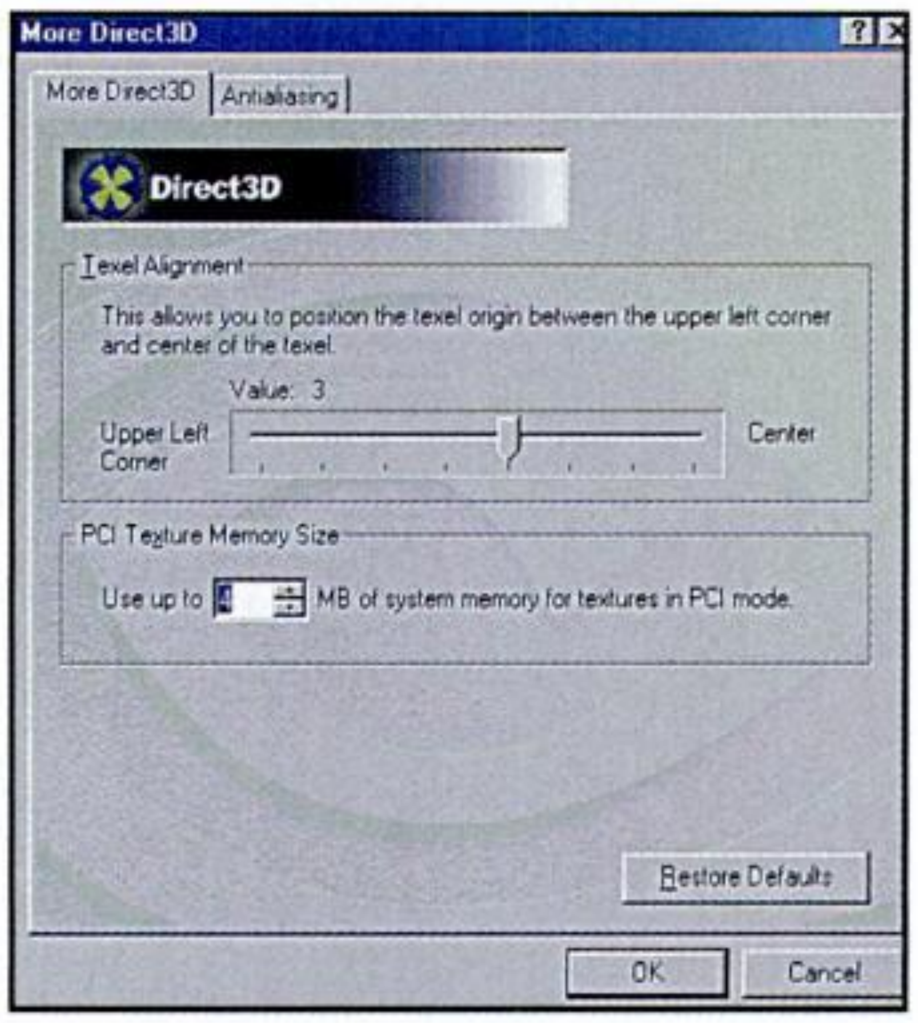
With its funky geometry and boatloads of textures, the *Quake III* Quaver timedemo is enough to bring the burliest videocard to its knees. But without more polygons it doesn't stress the AGP bus.

The nVidia guys also clued us in to what it would really take to measure the performance advantages of the AGP bus: high-triangle-count games. Apparently, *Quake III* isn't really one of those, since it averages only 10 to 15 thousand triangles a frame. That's less than a million triangles a second. *Quake III* pushes fill rates and textures, but it doesn't really do much in terms of high triangle count, so there isn't any way that *Quake III* is going to suffer from bus limitations, through texture traffic or command traffic.

Right now, the highest polygon count games are the titles coming out this fall, such as *Black and White*. nVidia recommended that we run Whole Experience's *Dragoth Moor Zoological Gardens* demo. It uses between 80 to 100 thousand polygons per frame. Unfortunately, the *Dragoth Moor* demo doesn't run on a TNT2, so until someone makes a PCI GeForce card, there really isn't a way for us to truly test the AGP bus with an isolation test. But for now, given the complexity of today's games, running your videocard on the AGP bus instead of the PCI bus only yields a few extra frames per second at the highest resolutions. ✸



Texel Alignment

This allows you to position the texel origin between the upper left corner and center of the texel.

Value: 3

Upper Left Corner — Center

PCI Texture Memory Size

Use up to 4 MB of system memory for textures in PCI mode.

By setting aside system memory, a TNT2 PCI can use it much like the AGP aperture setting.

WHAT A DIFFERENCE A DRIVER MAKES

We tested with nVidia's leaked 5.13 drivers because they fixed many of the texture management problems that plagued the TNT2 and GeForce. With the old 3.x drivers, it was widely assumed that the TNT2 and GeForce couldn't do proper AGP texturing. The 3.x drivers tried to load all the textures into local graphics memory, and paged them willy-nilly into system memory when there wasn't enough room on the videocard.

With the 5.x drivers, nVidia completely re-architected the way the driver handles textures by using a virtual texture management scheme that intelligently caches and migrates textures into and out of frame buffer memory. In situations where there isn't much texture memory, the most recently used textures will stay in local memory and the least recently used textures will be paged in and out. The biggest performance benefits from the 5.x drivers will come at high resolutions at high bit depths, in situations where there is very little local texture memory left—which is exactly the kind of situation in which you need strong AGP texturing.

Sheeeeeesh
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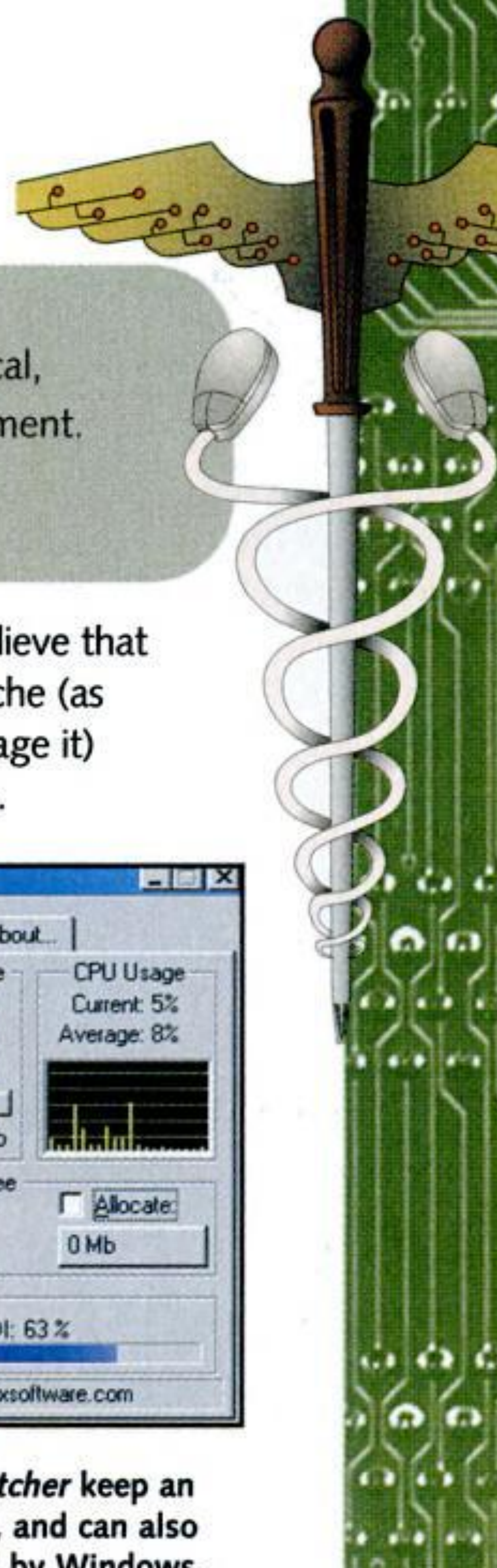

Symptom | Diagnosis | Cure

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Memory leak tweak

I have a 5-month-old Dell computer with a 500MHz P-III and 128MB of RAM. For some reason, after I have left my computer on for several days (in and out of standby mode), it seems as though my RAM is eaten up to the point where only a small percentage (less than 5%) is free. But I have only a couple of programs open—*Word, Winamp,* Juno (my ISP), *Internet Explorer, AIM, ICQ,* and whatever else is running in the background—but nothing significant enough to take up all that memory. It gets to be where I can't even open a window because there isn't enough available memory! I reformatted my hard drive about two months ago, yet the problem persists. Please give me some help or suggestions about where all of my RAM is going!

—Andy Obusek

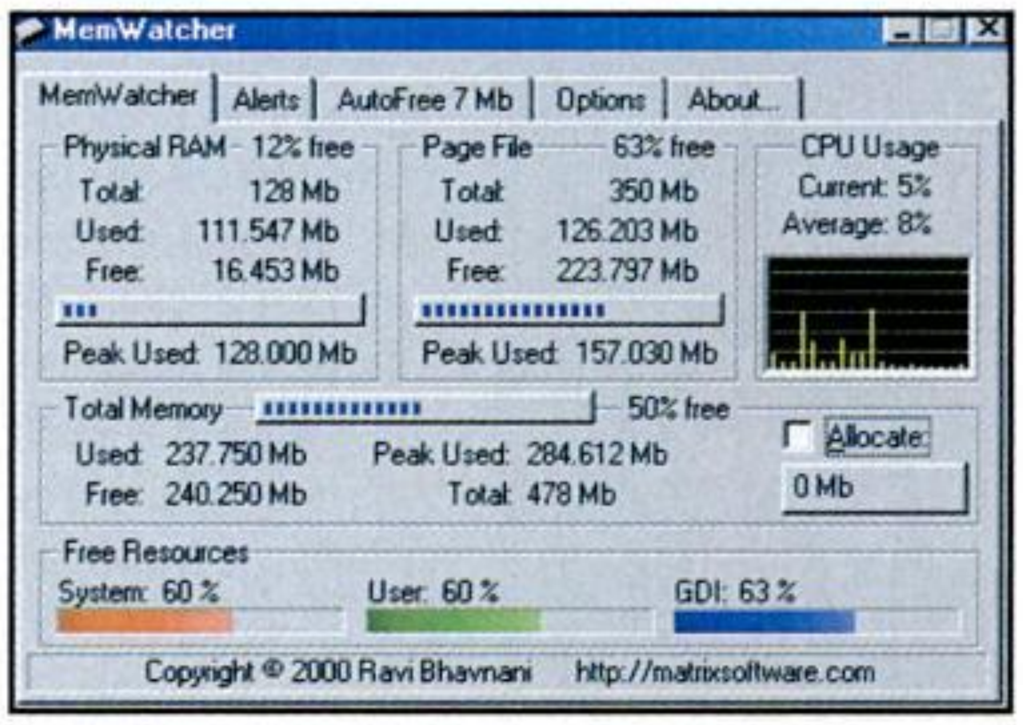
Dude, if your PC isn't sealed up, the RAM could be leaking through holes in the case.

Seriously, you're not running enough programs to eat up the entire 128MB of RAM you have, so you must be experiencing what's known as memory leaks. Whenever you use a program, a certain amount of system memory is allocated to it. Sometimes, programs don't allocate that memory properly, and when you close them, they don't let go of the RAM. Over time, all of your system memory just disappears, because it's being wasted by sloppy programming. Usually the blame lies with the software developer, but sometimes the perpetrator is Windows.

> **"Sometimes, programs don't allocate that memory properly, and when you close them, they don't let go of the RAM."**

First, be sure you're running the latest versions of all your applications and that you've installed the latest patches. For example, in the case of *Word 97*, install the SR-1 and SR-2 patches available from Microsoft. It also wouldn't hurt to do a clean install of Windows.

Second, be sure Windows isn't stealing more than its fair share. Microsoft claims to have fixed Windows' tendency to use the bulk of your system memory to cache information for your hard drive, but some people prefer to manually take care of this. To do so, edit your System.ini, adding the lines "MinFileCache=8000" and "MaxFileCache=8000" under the VCACHE section. You can adjust the amount of memory your system uses to cache, but be warned that some folks believe that manually setting your system's cache (as opposed to letting Windows manage it) can actually degrade performance.



```
Physical RAM - 12% free     Page File    63% free     CPU Usage
  Total        128 Mb         Total       350 Mb      Current: 5%
  Used     111.547 Mb         Used    126.203 Mb      Average: 8%
  Free      16.453 Mb         Free    223.797 Mb
Peak Used  128.000 Mb      Peak Used  157.030 Mb
Total Memory                 50% free
  Used  237.750 Mb      Peak Used  284.612 Mb      ☐ Allocate
  Free  240.250 Mb          Total  478 Mb          0 Mb
Free Resources
System: 60 %            User: 60 %            GDI: 63 %
Copyright © 2000 Ravi Bhavnani    http://matrixsoftware.com
```

Shareware programs such as *MemWatcher* keep an eye on system memory and resources, and can also reclaim memory no longer being used by Windows.

Third, you can download shareware applications, such as *MaxMem*, from **www.analogx.com** (look in the software section) or *Memwatcher* from **http://matrixsoftware.com**. These apps will clear out sections of unused memory and let you decide how much memory should be allocated to programs at any given time. Look for other memory recovery applications in the Windows section of **www.tucows.com**.

Athlon, crackle, pop

If you've read the *Maximum PC* online forums recently, you may have noticed a lot of people complaining about static and crackling coming out Athlon users' Sound Blaster Live! cards. I have an Athlon 700 with an Epox KX133 motherboard, 3D Prophet DDR-DVI, and SB Live! X-Gamer soundcard. Here is an example of when I experience this problem. When I start up *Team Fortress Classic*, I click on "Internet Games" and hear some static when playing a background sound file. Once I'm in the game playing, it's fine. I know it's not my soundcard because the Value works fine in the original P-III 600. I have tried multiple speakers, both digital and analog, and of course positioned them far away from the monitor. I am using the latest drivers and have no hardware conflicts. I have also tried

This month:

- **Tweak your leak**
- **Static stumper**
- **Monitor mojo**
- **Audio assumptions**

CHECK IT OUT **Online**
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moving my soundcard to different PCI slots, and have had no luck.

—John Belisle

After speaking with both AMD and Creative Labs about this, the problem was traced back to, not the Athlon or the SB Live!, but the Epox motherboard. In order to solve the crackling static problem, all that is necessary is a BIOS flash available from Epox's web site. According to the site, the BIOS dated 3/10/00 fixes "cracking sound problems when an additional soundcard is installed."

Delvin' Into Kelvin

Concerning monitors, what is the difference between 6500k and 9300k degrees? Which one is better to run at, or does it matter?

—David Conley

David is referring to the Kelvin color temperature options that are made available via most monitors' onscreen controls. Specifically, the controls adjust the subtle color variations in what is represented as "white" on your display. Lower temperature settings will produce a slightly reddish cast in otherwise pure whites, while higher settings produce a bluish cast.

What does color casting have to do with temperatures? Well, the scaling is based on Kelvin heat measurements. Heat up a carbon block to 6000 degrees Kelvin and it will emit a white light with a slightly reddish cast. Keep increasing the temperature, and the white light will take on a bluish cast in the 9300k to 10,500k range. Choosing which temperature to run is a matter of personal-preference. Many people prefer lower color temperatures because they offer a "warmer" cast. Play around and choose the temperature that's most pleasing to your eye.

Protracted extraction

I recently installed an HP9100i CD writer in my 450MHz Dell, which also has an NEC CD-ROM drive rated at 40x. However, when I copy music tracks directly from the NEC CD-ROM drive, the transfer rate maxes out at 4x. So, here is my question: Is this the fault of the NEC drive, and if so, what should I replace it with? A Kenwood 72X?

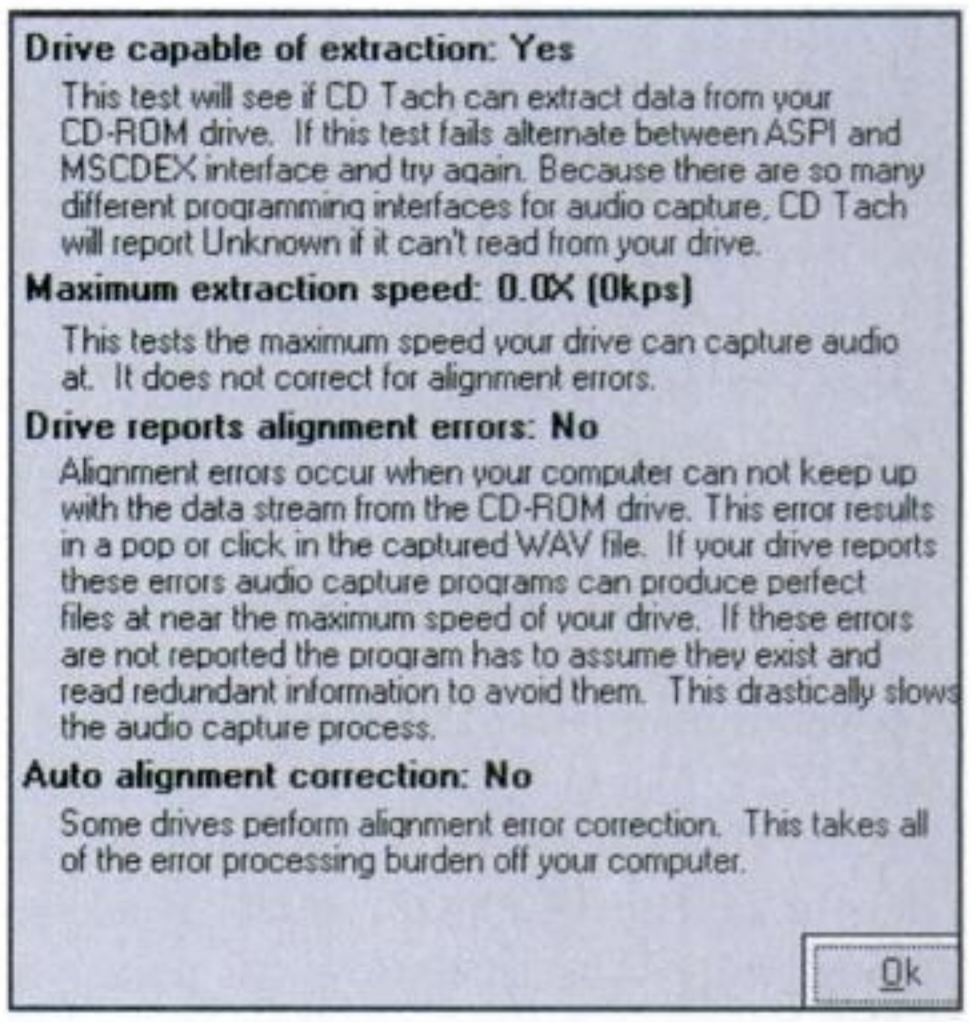
—Anh Nguyen

Your CD-ROM is extracting audio at a snail's pace because it's a task your drive was not designed to do. In general, variations in the speed of audio extraction are influenced by two factors: the design of your optical drive and the way audio is recorded onto a CD. CD-ROM drives are primarily designed to read data, not audio. Reading data is a breeze, because each data block contains both header and error-correction information. The drive's head knows exactly where data is located, so that no errors occur during the read process. Audio, on the other hand, fills the entire block with audio data, and includes no error-correction information and no header data. This means that if a drive has no built-in alignment features for audio, it could be off by as much as 75 sectors, or one second of audio playback.

> **"If a drive has no built-in alignment features for audio, it could be off by as much as 75 sectors, or one second of audio playback."**

If you think getting a faster drive will solve your problems, you're mistaken. Just because a drive can read data quickly does not mean it can accurately locate audio blocks. And just because a drive can locate audio doesn't mean it can extract it at anywhere near the drive's top speed.

For example, Kenwood's 72X True X drive is easily the fastest drive we've seen at audio extraction (it can hit 45x), but unfortunately, the drive has no error correction capability. Nor does it report errors to the software, which slows down the burning process. These two capabilities have to be engineered into a drive, and can't be compensated for with software tweaks.



Drive capable of extraction: Yes

This test will see if CD Tach can extract data from your CD-ROM drive. If this test fails alternate between ASPI and MSCDEX interface and try again. Because there are so many different programming interfaces for audio capture, CD Tach will report Unknown if it can't read from your drive.

Maximum extraction speed: 0.0X (0kps)

This tests the maximum speed your drive can capture audio at. It does not correct for alignment errors.

Drive reports alignment errors: No

Alignment errors occur when your computer can not keep up with the data stream from the CD-ROM drive. This error results in a pop or click in the captured WAV file. If your drive reports these errors audio capture programs can produce perfect files at near the maximum speed of your drive. If these errors are not reported the program has to assume they exist and read redundant information to avoid them. This drastically slows the audio capture process.

Auto alignment correction: No

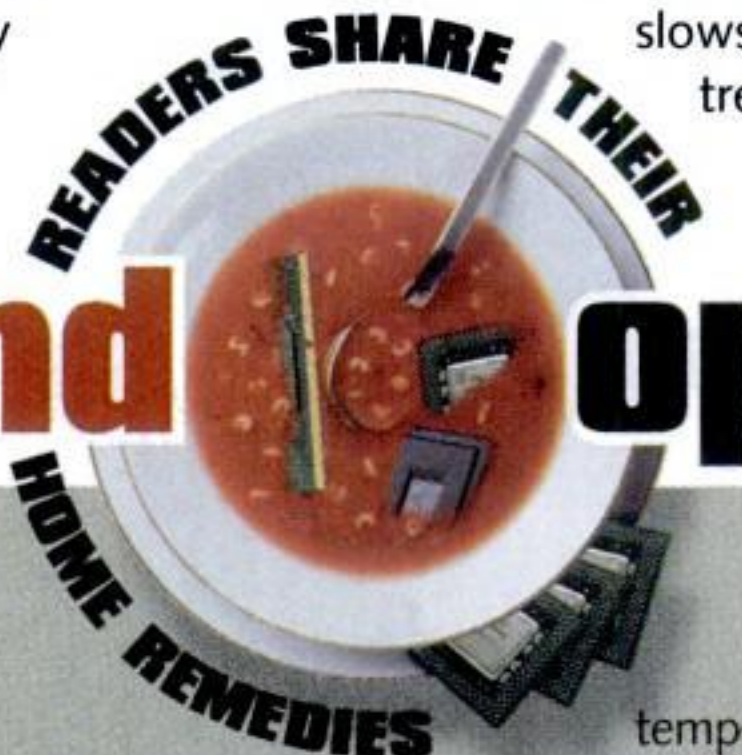
Some drives perform alignment error correction. This takes all of the error processing burden off your computer.

According to *CD-Tach*, Kenwood's 72X drive is capable of audio extraction, but doesn't report read errors and contains no error-correction capability.

For the most accurate audio duplication, go with a drive from Plextor or TDK. Both drives include pin-point alignment capability, so the drive can detect on its own whether or not it's reading from the correct location on the disk. Some drives try to do it in software, as stated above, but this slows the process down tremendously. ✸

READERS SHARE THEIR

second opinions



HOME REMEDIES

Heated Debate

The statement in the Feb 00 issue that adding a heatsink to a chip will lead to higher case temperatures has me worried that the staff's crack habits have gotten a little out of control. Heat (specifically power, as in watts) is being generated in that chip, so it will warm up the case no matter what you do. Heat flow can be modeled just like current flow. There's the heat source (measured in watts), which is usually the chip itself, then there are various thermal resistances (denoted by the greek letter theta, and expressed in degrees Celsius/watts), which generate a temperature difference when the heat passes through them. Typically there'll be ThetaJC (junction to case), ThetaCS (case to sink), and ThetaSA (sink to air). Add them up, multiply by the number of watts to dissipate, add that number to the air temperature, and you know how hot the poor little chip is gonna get. Now, I'm not sure whether it is better to cool a chip with a fan, or slap a heatsink on and blow the air over the fins. Adding the sink means adding more thermal resistance (because of the gap between the sink and the case), but if ThetaCS+ThetaSA are lower than ThetaCA, the sink would be the correct choice.

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THE MONTH IN REVIEWS

Life After One Gigahertz

Now that we've seen 1GHz CPUs from major vendors, we find ourselves staring into an abyss of uncertainty. Will P-III and Athlon speeds eclipse 1000MHz, or will we see nothing faster until Willamette and Thunderbird are released later this year? We're not sure, so in upcoming issues, we're hedging our bets and planning to review specialty systems, such as machines specifically configured for DV, audio production, and gaming.

While waiting for the new CPU cores, we'll be playing with a cornucopia of potentially stunning graphics cards from nVidia, 3dfx, and ATI. In fact, our August issue will feature *Maximum PC's* annual 3D card slugfest—hopefully, all the major players will have silicon available in time for it. Until then, check out this month's assortment of computing goodness.

— JOSH NOREM, REVIEWS EDITOR

BEHIND THE BENCHMARKS

This month: Motherboards

To test each mobo, we use a wide variety of hardware, as well as real-world and synthetic benchmarks. First we put the victim into an InWin Q-500 test case. Then we fill every open slot the board has with a vast range of hardware (listed on page 81). This procedure tests component compatibility and stresses the board's electrical capacity. Application testing begins with *SYSmark2000* and Adobe *Photoshop*. Because we team up each mobo with the same hard drive, CPU, videocard, and drivers, these two tests help isolate any desktop performance differences among boards.

For synthetic tests, we use *SiSoft Sandra 2000 Professional* Dhrystone and Whetstone benchmarks (**www.sisoftware.demon.co.uk/sandra**) to measure integer and floating-point performance. *SiSoft Sandra* also incorporates the STREAM test to measure memory throughput. Faster scores generally indicate faster performance.

We Don't Need No Stinkin' Wreest Straps!

OK, call us reckless, but we just don't "dig" all those fancy "safety procedures" (read "propaganda") evangelized by the electronic hobbyist industry. Our Lab has a linoleum floor with a big anti-static mat right at the entrance—who needs anything else?

"OK, everyone, listen up. I want to remind you to use proper grounding accessories before swapping out parts in your test systems. We lost four videocards and two NICs to static last month. Let's nip it in the bud."

"We always listen to Jon. Jon is good—or so say the subliminal tapes we have to listen to every night. So it's agreed: We'll all be more careful and wear our company-provided anti-static leashes when using our test systems."

"Proper grounding techniques? What a paranoid freak! Hey, do you smell ozone in here? Reminds me of summer storms in Rhode Island..."

A behind-the-scenes look at the Maximum PC Lab and the gearheads who work in it.

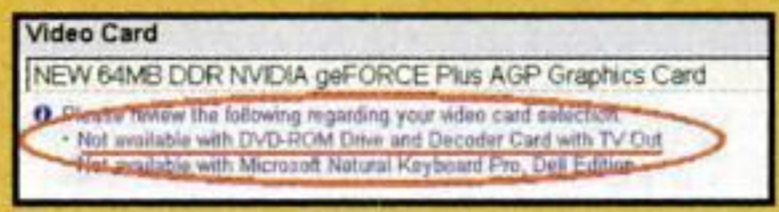
26 PRODUCTS REVIEWED!

RIGHTEOUS WEB SITE: REACTORCRITICAL.COM

REACTOR CRITICAL

Reactor Critical (**www.reactorcritical.com**) is all about the proliferation of hardcore 3D intelligence. Run by a group of Russian engineers, Reactor is *the* place to go for the latest drivers and leaked specs on upcoming graphics processors. We're guessing they have a few moles inside nVidia, because every set of leaked Detonator drivers has shown up at Reactor. The site also provides in-depth videocard reviews and incisive articles on the latest 3D technologies.

PUTTING DELL THROUGH HELL, PART THREE



Video Card

NEW 64MB DDR NVIDIA geFORCE Plus AGP Graphics Card

Please review the following regarding your video card selection:

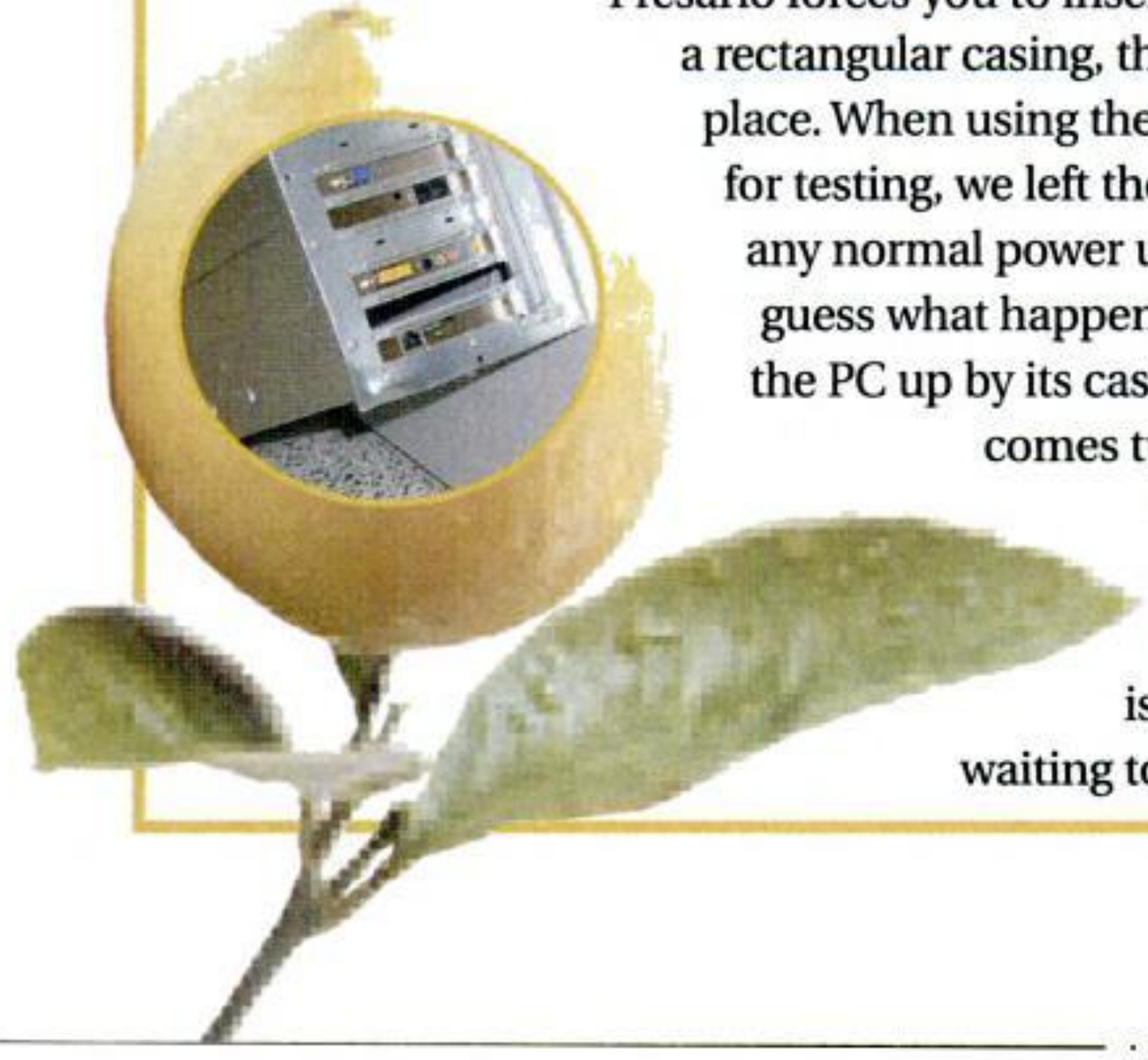
- Not available with DVD-ROM Drive and Decoder Card with TV Out
- Not available with Microsoft Natural Keyboard Pro, Dell Edition

For the past few months, we've been putting Dell and its "Perfect 10" XPS B800R system through torture tests. This month, however, Dell put us through hell. We received e-mail after e-mail complaining that Dell wasn't selling the system in the exact configuration that we reviewed.

A trip to Dell's web site confirmed this. When we used the online engine to configure the Perfect 10, a warning stated that we couldn't have the 64MB GeForce videocard in a machine that included the hardware MPEG decoder. We immediately called Dell for an explanation. Our press contact assured us the reviewed config was in fact available, and that the discrepancy was the result of a "web glitch." Harrumph.

After several days of calling Dell and fending off angry readers, we were notified that the web problem was cleared up, and that the system was available. That was March 22nd, approximately one month after our magazine hit newsstands. Technically, Dell made the configuration available within the month the issue hit, but the fix was late enough to upset many readers who wanted to buy the perfect box. Does anyone else hear that barking sound?

Lemon of the Month



Compaq's Crappy Case

Instead of a pop-off side panel, the latest Compaq Presario forces you to insert the chassis into a rectangular casing, then screw it into place. When using the system in the Lab for testing, we left the screws out—like any normal power user would do. So guess what happens when you pick the PC up by its casing? The chassis comes tumbling out onto the floor! Sorry, Compaq, this case design is an accident waiting to happen.

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Benchmarking: Full Disclosure

www.maximumpc.com/benchmarking for the complete lowdown on the *Maximum PC*'s benchmarking strategies.

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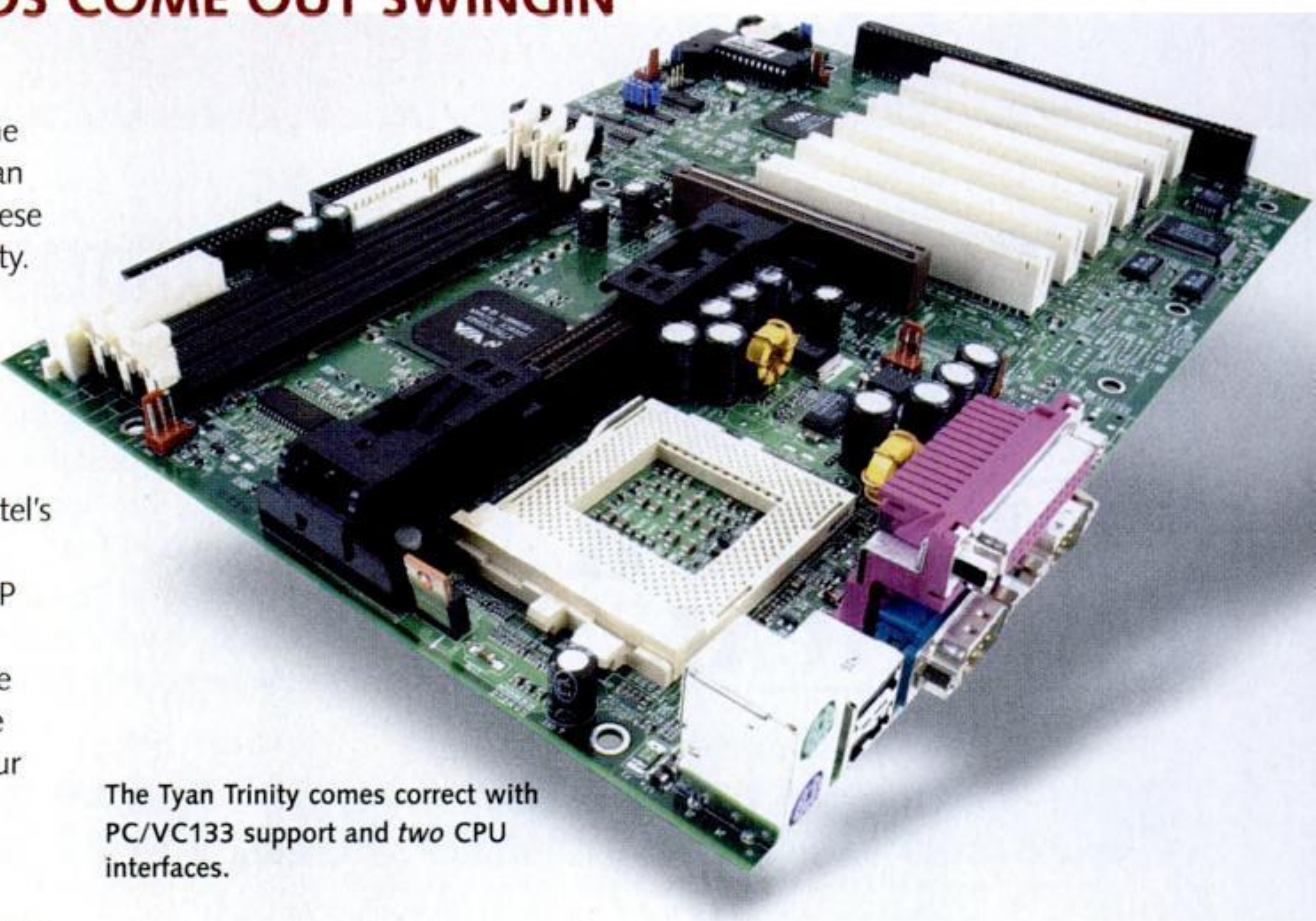
Intel Motherboard Mayhem

PENTIUM III MOBOS COME OUT SWINGIN'

If you thought your job was over when you opted to build a machine based on a Pentium III instead of an Athlon, you're sorely mistaken. These days, Intel opens up options aplenty. Should you go with RDRAM or PC133? Intel or VIA chipsets? PC800 or PC700? VC133 or PC133? No matter what you decide, if you're set on a modern Intel-based PC, you'll use either Intel's 820 chipset or VIA Technologies' Apollo Pro 133A. Both feature AGP 4x with support for fast writes, as well as ATA/66 and memory of the post-PC100 persuasion. Below, we look at two top contenders for your Intel-based mobo lovin'.



The Tyan Trinity comes correct with PC/VC133 support and *two* CPU interfaces.

TRINITY

PLUSES
- S370 and Slot 1 connectors
- Six PCI slots
- PC/VC133 support

MINUSES
- Hard jumpers
- PC/VC133 support

SOYO

PLUSES
- Overall better performer

MINUSES
- Bad LED pin locations
- RDRAM is pricey

Tyan Trinity 400

Those familiar with Micron's kick-ass Millennia Max machines will recognize the Trinity 400. Equipped with VIA's Apollo Pro 133A chipset, an AGP slot that will accept both 2x and 4x graphics cards, and a honking six PCI slots, this board was the first kid on the 133MHz frontside bus block when it arrived last fall. There's always a price to pay for being first, however. Since November, Tyan (**www.tyan.com**) has been continually updating the board to compensate for a horde of new Intel CPUs, as well as new AGP graphics cards. At revision 4, the Trinity is now looking strong and stable.

The most noticeable feature of the Trinity 400 is the incorporation of a Socket 370 alongside the familiar Slot 1 connector. The setup lets you run the original Celeron in Plastic PGA and the new Flip-Chip PGA P-IIIs, as well as Slot 1 Celerons, Katmai P-IIIs, and Coppermine P-IIIs. Don't get too excited, because you can't plug CPUs into both connectors and run them in SMP mode. To accommodate the socket/slot combo, Tyan had to move the DIMM slots extremely close to the power and EIDE connectors. The fit can make extracting or adding memory a tight squeeze.

Another annoying issue is the awkward connector block for the power, reset, and LED lights. Though a plastic shield is used to protect the pins from being bent, they're confusingly labeled and can block the insertion of a long PCI card, such as an old-school Voodoo2, into one of the slots.

We were also annoyed by the lack of soft-jumper settings that would have allowed us to set the CPU multiplier and bus speeds; you're simply given hard jumpers that let you define multipliers. Bus speeds auto-select as a result; the highest setting possible is 8.0 x 133MHz for 1064MHz. Combined with a lack of manually adjustable voltage, that makes the Trinity 400 a bad choice for hardcore overclockers.

On the positive side, the Trinity 400 features four three-pin power plugs for such things as CPU fans and other accessories. Here's a tip: If you're going to run dual fans on your processor, look for a heatsink with separate power leads. Simply combining two fan leads into one could lead to problems if the power requirements of the fans overload the motherboard.

BIOS features unmasked in the Award BIOS are excellent. You can tinker with memory settings, play with buffering settings from the CPU to the PCI bus, and experiment with such mysterious settings as "AGP Driving Value." We use the word mysterious because, while the Trinity 400's manual is good, it doesn't do justice to the amount of tinkering one can do. (The AGP Driving Value actually lets you tweak the board for inconsistent AGP implementations on various videocards.)

Knowing how painful VIA-based chipsets were in the Super 7 days, we expected some problems in our compatibility testing, but we were pleasantly surprised. During the test in which we loaded every mobo orifice with hardware, the Trinity 400 exhibited no conflicts (see the chart for our hardware list.) The only complication was in having to load VIA's 4-in-1 drivers prior to testing, as Windows 98SE doesn't natively support the VIA chipset.

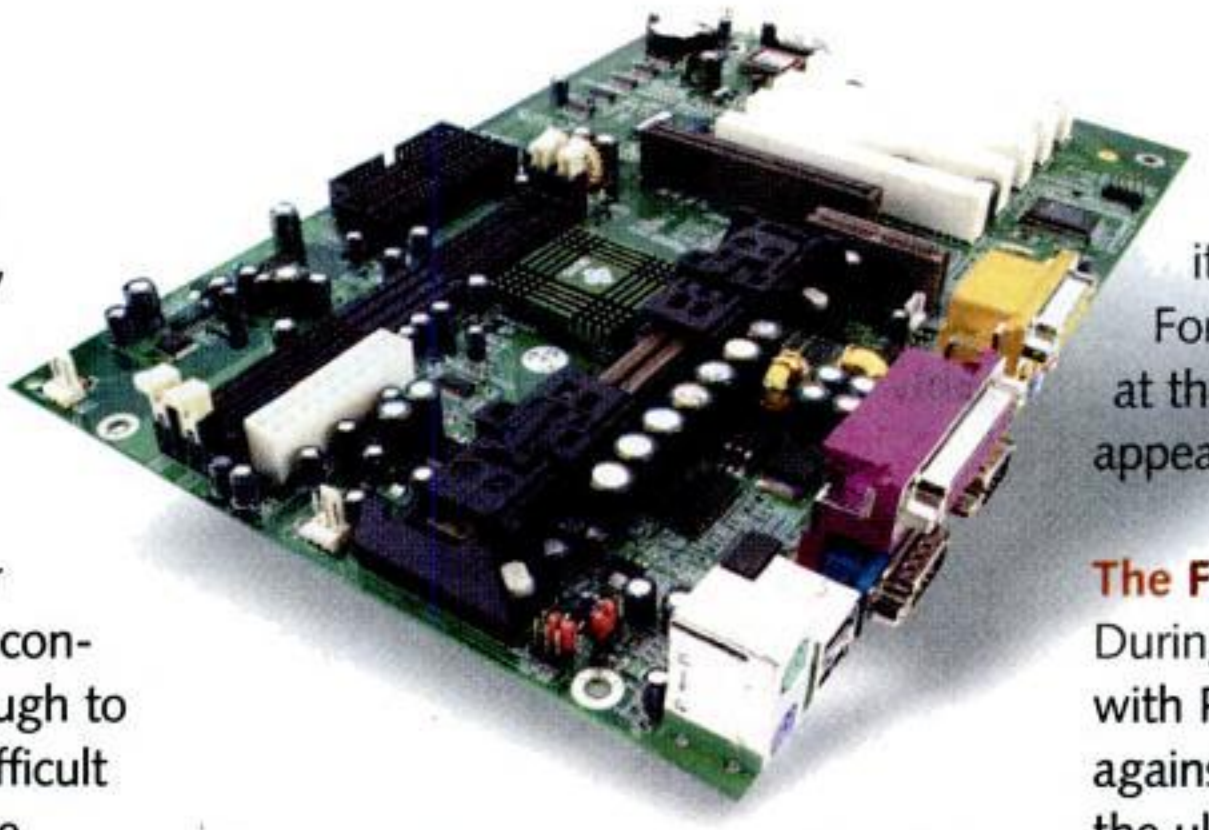
Soyo SY-6ICA

Soyo's SY-6ICA (**www.soyousa.com**) carries the flag for Intel in this contest, and is strikingly similar to Intel's reference "Vancouver" VC820 design. The SY-6ICA features five PCI slots and a single AGP slot with support for 2x and 4x AGP, as well as an AMR slot and onboard audio by Yamaha. For our tests, we disabled the audio CODEC in the BIOS. The board sports two RIMM slots for a maximum of 1GB RDRAM (assuming you're using 512MB RIMMS—approximate cost: $15,000 US).

Board layout is fine except for the

pin locations of the power and reset switches, and power LED, all of which are at the bottom of the board. In our Inwin Q500 test case (which is several feet tall), the reset and LED cables wouldn't stretch far enough. Doh! The ATX power connector is also parked close enough to the memory slots to make it difficult to pull memory unless you have slender fingers.

The SY-ICA includes a trio of three-pin power connectors for the CPU and motherboard fans. Like the Tyan board, the 820 chipset required a separate set of drivers to be installed after the initial Windows 98SE load.



The Soyo features support for both PC700 and PC800 RDRAM. Pricey but fast.

Overall CPU speed is set within the BIOS, and the board is certified up to 1GHz. Core CPU voltage can be massaged manually, but you'll have to move physical mobo jumpers to do so. Feh! At the risk of stating the obvious, we don't like fiddling with jumpers!

Like the Tyan board, the Soyo made it through our compatibility testing with nary a scratch. We did, however, run into a problem when the board would spontaneously forget our Soyo engineers that we spoke with said they suspected the board had failed. It hadn't failed. So, what, it came down with amnesia? Fortunately, the problem occurred at the end of our testing, and didn't appear to affect benchmarks.

The Final Word

During testing, we pitted the Tyan with PC133 and VC133 SDRAM against the Soyo with PC700 and the ultra-rare PC800 RDRAM. Both systems had the exact same CPU, videocard, drivers, case, and hard disk, and were loaded with an OS from the exact same Windows 98SE CD.

In *SYSmark2000*, the Soyo board with PC800 beat the Tyan by nine points—a notable margin, considering the only differences were motherboard and memory. We've seen the same kind of boost in *SYSmark* by adding hard disk arrays or an additional 50MHz in CPU speed. Even the PC700 did well compared to SDRAM. Score one for 820 and the Soyo.

The 820 board scored again in the *SiSoft Sandra 2000* memory bandwidth test. *SiSoft* executes various instructions to gauge the overall throughput of the computer. It's no surprise that the PC800 RDRAM system whupped SDRAM. The Tyan equipped with VC133 gave RDRAM a good run for its money, but clearly Rambus has the edge here.

In *3DMark*, the Soyo again proved victorious by a wide margin. The *3DMark* relies heavily on AGP performance and memory, and the 820 has the edge.

But it wasn't a total victory for RDRAM. Just when we thought we'd settled the performance question, the Tyan stumped us by being five frames faster in *Quake III Arena*. The Tyan board also whomped the Soyo in *bootMark*, which tests integer and chipset performance. Huh? It's clear the 820's advantage in bandwidth doesn't always add up to better everywhere, but it fared far better than we expected.

—Gordon Mah Ung

Got an
opinion
on this
article?
Join the debate!
mpccp.com

DARE TO COMPARE

MANUFACTURER	**TYAN**	**SOYO**
Model	Trinity 400 S1854	SY-6ICA
Chipset	VIA Apollo Pro 133A	Intel 820
BIOS	AMI	AMI
Expansion Slots	1 AGP/ 6 PCI / 1 ISA	1 AGP / 5 PCI / 1 ISA
Memory Slots/ Max Memory	3/1.5GB	2/1GB
Ports	2 serial, 2 USB, 1 parallel, 1 PS/2 mouse, 1 PS/2 keyboard	2 serial, 2 USB, 1 parallel, 1 PS/2 mouse, 1 PS/2 keyboard
IDE	ATA/66	ATA/66
Form Factor	Baby ATX	Baby ATX
Compatibilitiy Rating?	Excellent	Excellent
Overclocking Rating?	Fair	Fair
Memory	PC133 "Turbo," PC133 "Normal,"	VC133 "Normal" PC700/PC800 Direct RDRAM

NOTE: The Tyan Trinity allows tweaking of memory speeds. We tried normal and turbo modes for our testing. The VC133 would not run in turbo mode.

BATTLE OF THE BENCHMARKS

MOTHERBOARD/ MEMORY	**TRINITY PC133**	**TRINITY VC133**	**SY-61A PC800**
Quake III Arena	49.7 fps	**49.9 fps**	45.5 fps
BootMark	**423**	409	406
3DMark 3DMarks	4859	4744	**4927**
3DMark CPUMarks	308	324	**343**
3DMark 64MB Texturing test	82.6 fps	80.1 fps	**92 fps**
SiSoft Sandra 2000 *Pro* MIPS	2144	2153	**2157**
SiSoft Sandra 2000 *Pro* MFLOPs	1067	1070	**1072**
SiSoft Sandra 2000 *Pro* Stream Integer	228 MB/s	356 MB/s	**377 MB/s**
SiSoft Sandra 2000 *Pro* Stream FPU	255 MB/s	402 MB/s	**479 MB/s**
Photoshop 5.5 MPC	167 sec	168 sec	165 sec
*SYSmark*2000	157	159	**168**

NOTES: Best scores are bolded. Settings for *Quake III Arena*: 1.16n 1024x768, 32-bit color, trilinear filtering, maximum textures, 32-bit textures, Demo 1. Settings for 3DMark test: 1024x768, 16-bit color, double buffered, T&L duties handled by CPU. Test bed: Windows 98, Quantum Fireball KA ATA-66, 800MHz "EB" Pentium III, Elsa Erazor X2 DDR GeForce, Crucial Technology PC100/PC133 SDRAM, NEC VC133 memory, Samsung PC700/PC800 Direct RDRAM. Compatibility Equipment: 3Com 3C905B 10/100NIC, Diamond Dual V.90 Shotgun ISA modem, Diamond 12MB Voodoo2, Sound Blaster Live! X-Gamer, Adaptec 2940U2W, Logitech USB Mouse, Logitech/Storm USB Scanner.

TYAN TRINITY 400 **8**

$120 | Tyan
Buy www.seemebuyme.com
877.751.7467 ID#0610

SOYO SY-61CA **8**

$140 | Soyo
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Firewall Fisticuff

SOFTWARE SOLUTIONS KEEP YOUR PC SAFE ONLINE

In the wake of some high-profile (if not very serious) denial-of-service (DoS) attacks on web sites, protecting your PC is suddenly about more than a virus checker and a Jolt Cola-proof keyboard skin. With the recent influx of DSL and cable service, humble desktops are becoming always-on Internet ports of call, and you may be sorry if you don't take some basic precautions. We checked out Symantec's *Norton Internet Security 2000* (**www.symantec.com**), McAfee's *Personal Firewall* (**www.mcafee.com**), and Network ICE's *BlackICE Defender* (**www.networkice.com**), to see which firewall is best at keeping the vault shut.

NORTON

PLUSES

- True rules-based firewall
- Loaded with features

MINUSES

- Hard to pinpoint attacks in realtime
- Not cheap

MCAFEE

PLUSES

- App level network control
- Excellent network activity monitor

MINUSES

- Limited firewall rules
- Limited-time license

BLACKICE

PLUSES

- Detailed ID of net attack and attacker
- Can block any IP

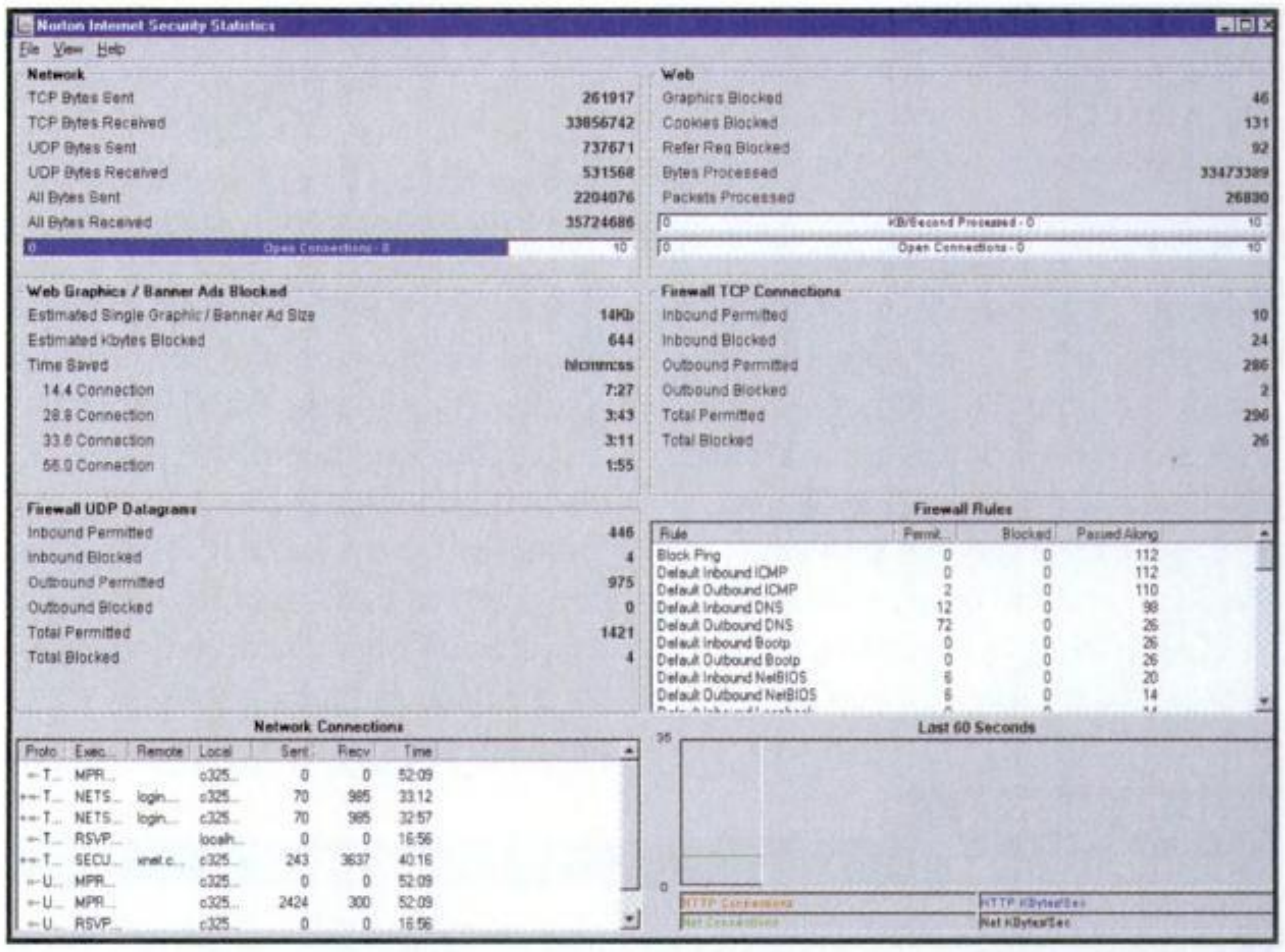
MINUSES

- IP-only firewall rules
- Poor interface

Norton Internet Security 2000

Though the firewall takes center stage in *NIS2000*, the package has a slew of other features that offer enhanced desktop protection from the Internet baddies. Parental controls and ad-blocking are included, along with a privacy feature that monitors standard HTTP transmissions and ensures that user-defined data (such as your address or credit card number) is never sent over unsecure channels. Symantec also tosses in the 2000 edition of its antivirus product.

NIS2000 includes one year of free updates—not quite the "free for life" deal we'd prefer, but better than a yearly renewal requirement. After one year with Norton, your firewall will still be operative, but you have to pay $4 annually for updates. With McAfee, you have to repay the $40 to renew the service.



Network	
TCP Bytes Sent	261917
TCP Bytes Received	33856742
UDP Bytes Sent	737671
UDP Bytes Received	531568
All Bytes Sent	2204076
All Bytes Received	35724686

Web	
Graphics Blocked	46
Cookies Blocked	131
Refer Req Blocked	92
Bytes Processed	33473389
Packets Processed	26830

Web Graphics / Banner Ads Blocked	
Estimated Single Graphic / Banner Ad Size	14Kb
Estimated Kbytes Blocked	644
Time Saved	hh:mm:ss
14.4 Connection	7:27
28.8 Connection	3:43
33.6 Connection	3:11
56.0 Connection	1:55

Firewall TCP Connections	
Inbound Permitted	10
Inbound Blocked	24
Outbound Permitted	286
Outbound Blocked	2
Total Permitted	296
Total Blocked	26

Firewall UDP Datagrams	
Inbound Permitted	446
Inbound Blocked	4
Outbound Permitted	975
Outbound Blocked	0
Total Permitted	1421
Total Blocked	4

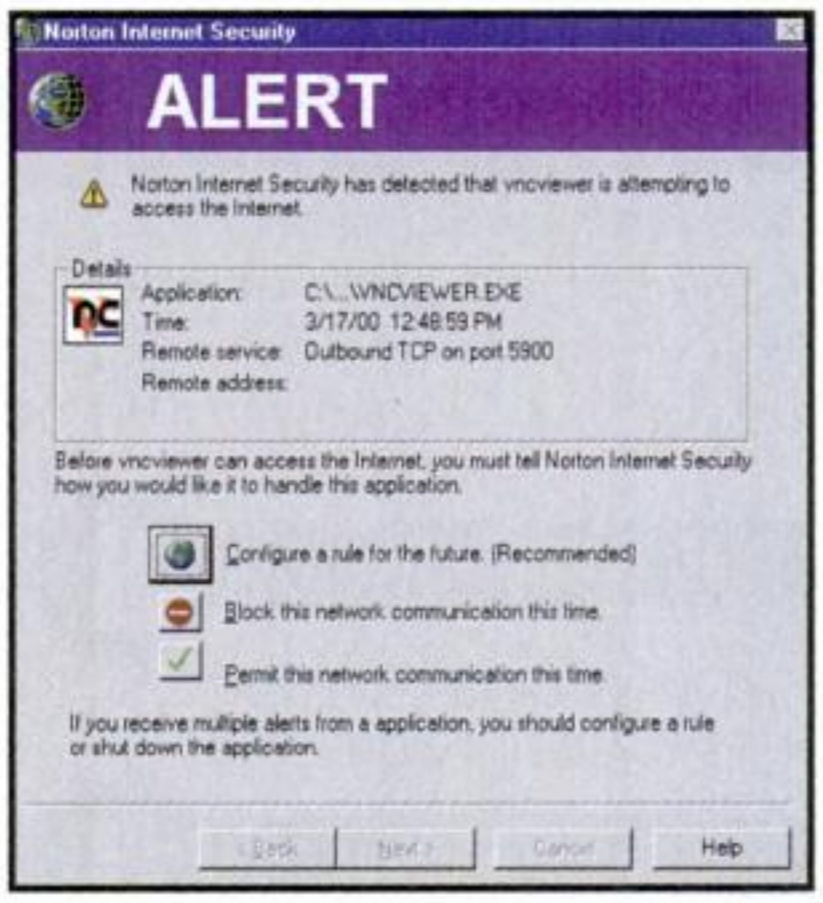
Firewall Rules

Rule	Permit...	Blocked	Passed Along
Block Ping	0	0	112
Default Inbound ICMP	0	0	112
Default Outbound ICMP	2	0	110
Default Inbound DNS	12	0	98
Default Outbound DNS	72	0	26
Default Inbound Bootp	0	0	26
Default Outbound Bootp	0	0	26
Default Inbound NetBIOS	6	0	20
Default Outbound NetBIOS	6	0	14

Network Connections

Proto	Exec...	Remote	Local	Sent	Recv	Time
T...	MPR...		c325...	0	0	52:09
T...	NETS...	login...	c325...	70	985	33:12
T...	NETS...	login...	c325...	70	985	32:57
T...	RSVP...		localh...	0	0	16:56
T...	SECU...	xnet.c...	c325...	243	3637	40:16
U...	MPR...		c325...	0	0	52:09
U...	MPR...		c325...	2424	300	52:09
U...	RSVP...		c325...	0	0	16:56

***Norton IS 2000's* advanced statistics screen gives you the realtime lowdown on current and recent network activity—including the stuff you're trying to block.**



Norton Internet Security has detected that vncviewer is attempting to access the Internet.

Details

Application: C:\...\VNCVIEWER.EXE
Time: 3/17/00 12:48:59 PM
Remote service: Outbound TCP on port 5900
Remote address:

Before vncviewer can access the Internet, you must tell Norton Internet Security how you would like it to handle this application.

Configure a rule for the future. (Recommended)

Block this network communication this time.

Permit this network communication this time.

If you receive multiple alerts from a application, you should configure a rule or shut down the application.

With *Norton's* firewall running, you're prompted to allow or deny any new attempt at network access.

NIS2000's masterpiece is the firewall feature, which works well and is easy to configure. When an application tries to access your machine, NIS2000 executes what is essentially a firewall configuration wizard, prompting you to permit, temporarily permit, or deny the access that the application is requesting. You can give the firewall program carte blanche over your entire network, or restrict its work to specific network ports—a useful feature if you suspect that a program is sending out more information than it's supposed to.

Symantec pre-loads its firewall with both common-sense security measures and myriad defenses against specific PC attacks and trojan programs, such as Back Orifice, that let a hacker control your PC remotely. Symantec provides LiveUpdate service so you can regularly freshen up the list of rules that govern your transmissions.

By default, *NIS2000* treats all of your network connections equally, so your dial-up networking connections are protected just as fiercely (or loosely) as your LAN or cable/DSL hookup. You can get around this by loading different security profiles based on your connection at a given time. For instance, the security settings for your DSL account may vary from those of your home LAN, so you can choose which profile to use. You can also tweak the advanced firewall settings to apply only to, say, your modem's IP address. It's tedious, but effective.

When assaulted with a combination of test probes, Norton denied access to all points of entry and made an appropriate note of the attacks. One caveat: By default, the firewall will actively block certain types of probes, rather than passively ignoring them. Some network experts recommend ignoring certain access requests because it makes attackers think your computer doesn't exist. If you agree that ghosting is superior to blocking, you'll need to adjust the firewall configuration.

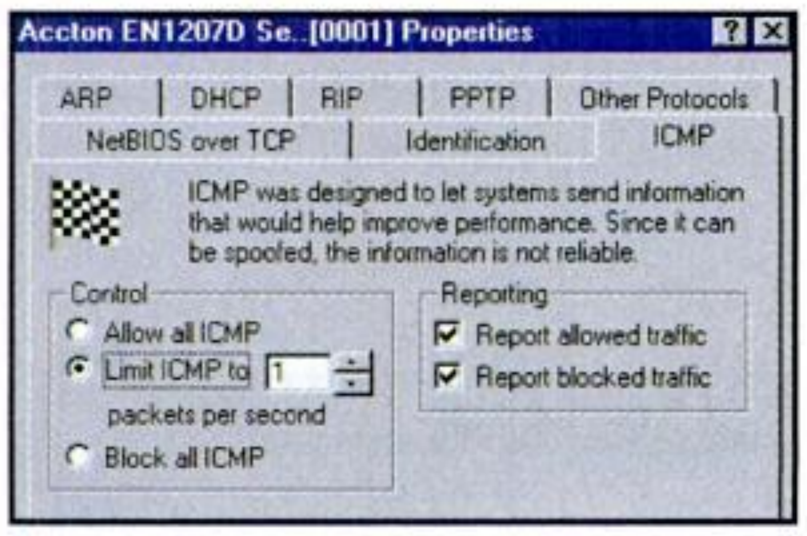
Personal Firewall

Not to be outdone by its rivals at Symantec, McAffee bought noted firewall developer Signal 9 and re-branded its *Private Desktop* product as the McAfee *Personal Firewall*. Though less reliant on wizards than the *Norton* firewall, *Personal Firewall* provides almost the same level of security found in *Internet Security 2000*, with fewer spurious extras.

Personal Firewall allows you to control which programs have access to the outside world. When adjusted properly, it should keep trojan programs from sending data from your PC without your consent. Although you can't preemptively add suspicious applications to the "blocked" list, when *PF* is in its default mode, any app that tries to hit the network for the first time will generate an alert and a request for access. Granted, this won't protect against trusted apps doing something untoward, so if a virus coerces *Outlook* into spamming your friends and *Personal Firewall* trusts *Outlook*, the mail will get through.

Personal Firewall lets you assign completely different security profiles to each of your network adapters. It won't, however, work properly if you're using two Ethernet cards and Win98 SE to provide Internet connection sharing to a LAN—sorry, Sport, *PF* won't co-exist with 98 SE's network address translation (NAT) wizard. Gateway-class protection costs more.

One thing we didn't like is the fact that you can't actually buy *Personal Firewall*—you can only sign up for a one-year "subscription license." That's right, McAfee is taking the "software is a service" approach. It means that after one year, you've spent more money than you would have if you had bought *NIS2000*. Presumably, the subscription system will motivate McAfee to keep its product up-to-date so customers won't ditch it. We'll see.



ICMP was designed to let systems send information that would help improve performance. Since it can be spoofed, the information is not reliable.

Control
○ Allow all ICMP
● Limit ICMP to 1 packets per second
○ Block all ICMP

Reporting
☑ Report allowed traffic
☑ Report blocked traffic

McAfee's *Personal Firewall* can defend against primitive (but effective) ping floods.

Personal Firewall performed like a champ during our battery of simultaneous attacks on common entry ports, such as NetBIOS, FTP, and ping. Although the main interface looks cluttered, the detail pays off when you see it in action—each protocol or port being probed shows up as a flashing red box, giving you a real-time look at the services an outsider is trying to access.

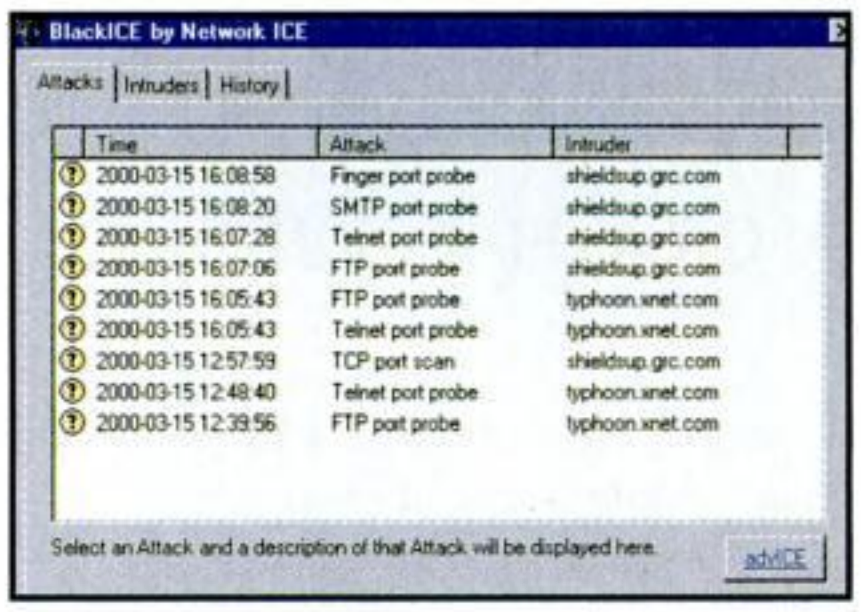
BlackICE Defender

While other firewalls simply secure your system and hope intruders will scurry off, *BlackICE Defender* wants to be sure the bastards don't get away with it. This firewall is billed as an "anti-hacker device" because it spots malicious attacks, records everything that happens, and offers assistance via IP reporting in bringing the scumbag to justice.

Every moment of suspicious network activity is logged in *BlackICE Defender*, along with a description and a severity rating based on the program's analysis of the attacker's intent. *BlackICE* is programmed to recognize a wide variety of conventional Internet assaults and Windows-specific attacks. It will grab as much information as possible about the intruder, but for all its attention to details, *BlackICE* does not by default report ping requests. Since ping requests are a staple means of identifying (and sometimes overloading) a networked computer, this is very disappointing.

BlackICE's firewall offers four levels of protection: trusting, cautious, nervous, and paranoid. You can indicate whether an IP address should be trusted or blocked, and you can only block an IP if it has been logged as an attacker.

Although you can sort the logged attacks by date, attacker, or type, *BlackICE* doesn't provide a realtime view of all current connections or service requests to your machine, and there's no way to view the complete activity log within *BlackICE* itself. And the app doesn't close cleanly—even after you've closed the *BlackICE* application, you're forced to delve into Ctrl-Alt-Delete in order to remove the network daemon that monitors your system.



Time	Attack	Intruder
2000-03-15 16:08:58	Finger port probe	shieldsup.grc.com
2000-03-15 16:08:20	SMTP port probe	shieldsup.grc.com
2000-03-15 16:07:28	Telnet port probe	shieldsup.grc.com
2000-03-15 16:07:06	FTP port probe	shieldsup.grc.com
2000-03-15 16:05:43	FTP port probe	typhoon.xnet.com
2000-03-15 16:05:43	Telnet port probe	typhoon.xnet.com
2000-03-15 12:57:59	TCP port scan	shieldsup.grc.com
2000-03-15 12:48:40	Telnet port probe	typhoon.xnet.com
2000-03-15 12:39:56	FTP port probe	typhoon.xnet.com

Select an Attack and a description of that Attack will be displayed here.

***BlackICE Defender* keeps an eye on all unauthorized attempts to access your PC.**

Aside from not alerting you to ping requests, *BlackICE* is a tight security net. All major attack points were properly ghosted, making them invisible to the outside world. With its charming attack graphs, *BlackICE* is like a realtime stock ticker: Watching it work is fascinating, but for 99 percent of the population, it's a waste of time.

The Final Word

With these desktop firewalls, the real distinctions are not in raw firewall capability, but in flexibility and user information. *BlackICE* provides adequate protection and lets you hunt down bad guys, but misses the point of what a desktop firewall should do: guard your system and make your computer's online presence as inconspicuous as possible. McAfee's *Personal Firewall* does a notable job of providing simple-yet-effective PC protection, though the subscription model is unfortunate.

In this group, *Norton Internet Security 2000* is the overall winner. You may not care to use the parental control or data security features, and if you're actively hunting a hacker it shouldn't be your first choice, but its firewall wins in terms of both configurability and manageability.

—*Jason Compton*

NORTON INTERNET **9**

$60 | Symantec
Buy www.SeeMeBuyMe.com
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MCAFFEE FIREWALL **8**

$40 | McAfee
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0613

BLACKICE DEFENDER **7**

$40 | Network ICE
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0614

Soldier of Fortune

A CRASH-COURSE IN FIRST-PERSON-SHOOTER CLICHÉS

PLUSES

- Model animations are superb
- Gore zones are fun to play with
- Abundant multiplayer options

MINUSES

- Clichés abound
- Cramped level design
- Few surprises

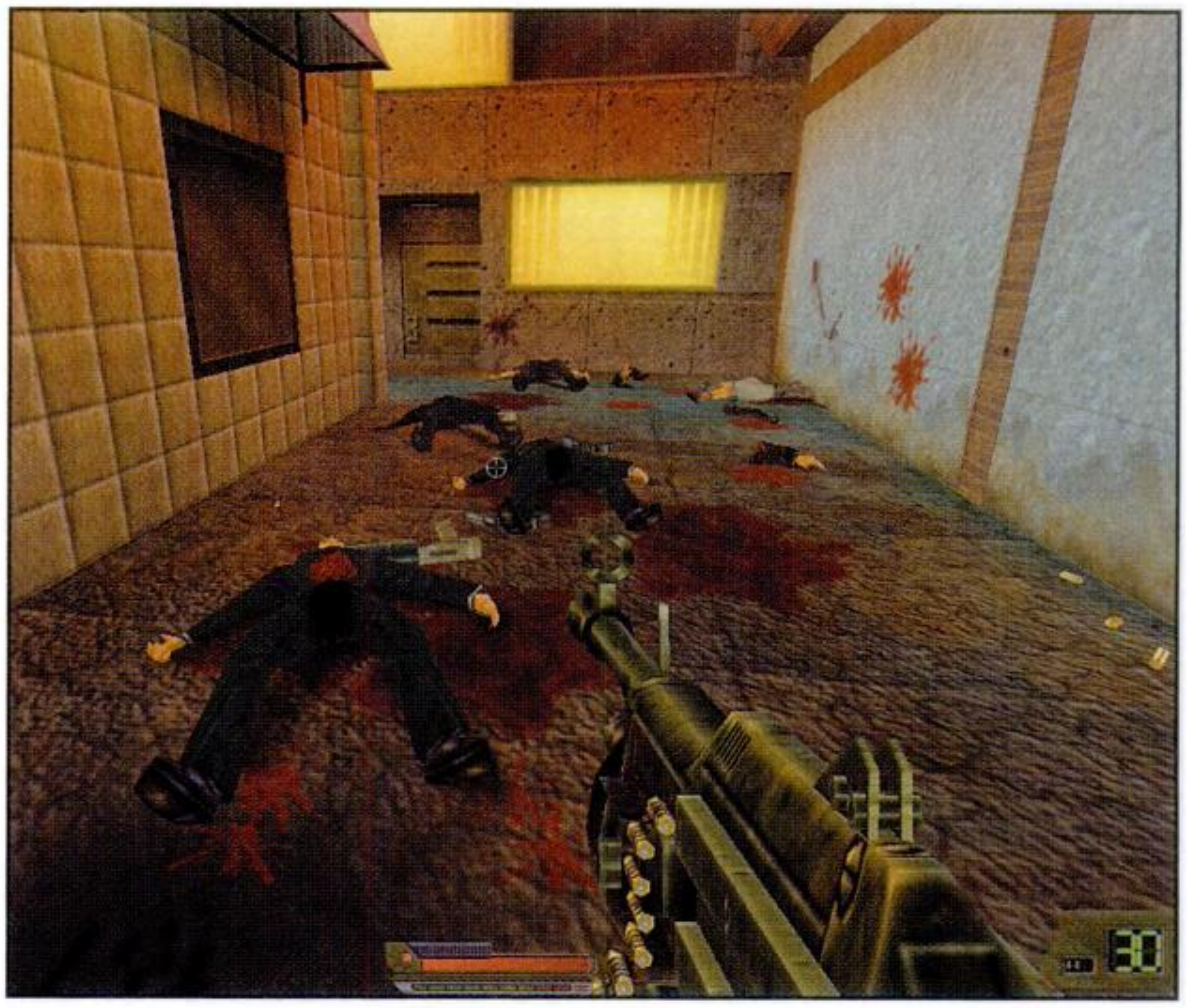
THE SPECS

3D CARD SUPPORT	Open GL
3D SOUND SUPPORT	DirectSound I EAX I A3D 2.0
MULTIPLAYER	TCP / IP I IPX I LAN
NUMBER OF PLAYERS	16

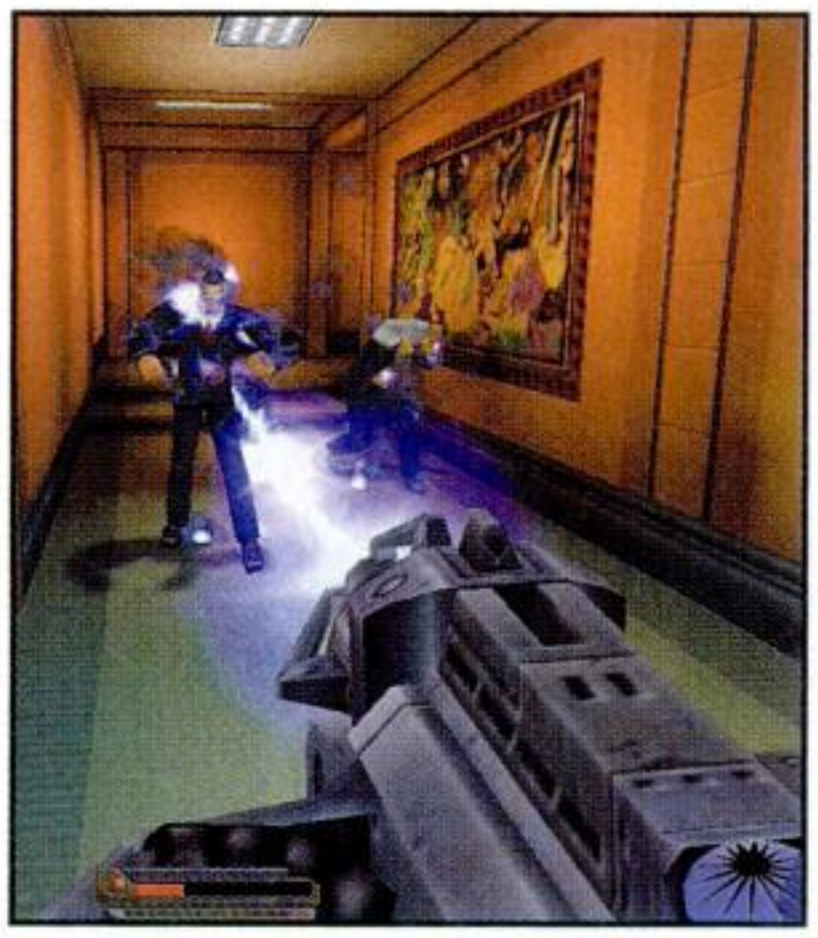
Playing *Soldier of Fortune* by Raven (**www.ravensoft.com**) is like taking a blood-soaked stroll down a first-person-shooter memory lane. The game has body-specific damage zones—just like in *Kingpin*. You'll have to turn on a power generator at some point—just like in *Quake II*. You'll get captured at some point—just like in *Half-Life*. If *Soldier of Fortune* scared us as much as *Half-Life*, or offered the same level of righteous graphics as *Kingpin*, we'd love it. But a thriller this is not, and no amount of gratuitous violence can make up for it's startling mediocrity.

Actually, the violence threshold is about the only place that *Soldier of Fortune* pushes the envelope. Every character model has 26 "gore zones," each with its own animation and pain skin. Shoot somebody in the toe and he'll lift his foot and hop around screaming as blood drips out of his Nike. Blast someone in the groin and his intestines come out the backside. It goes without saying that extremities can be blown off as well. Sick and twisted? For sure. But it's also the most accurate hit-detection system ever to appear on a PC.

The rendering system enabling this level of detail is called GHOUL, and it was made possible by combining the *Quake II* engine with a rendering and model system called SPECTRE. Raven was working on SPECTRE even before *Soldier of Fortune*'s formation. Many new features beef up the otherwise obsolete *Quake II* engine,but the most ambitious are the gore zones and the addition of 32-bit color, hardware T&L, and specular lighting. Hardware T&L in *Soldier of Fortune* allows for faster rendering, and lets GHOUL use more light sources in a given environment, but we didn't see any frame rate increase. That was a shame, since frame rates were low enough to make us consider dropping the resolution from 1024x768 to 800x600 on a few occasions (we played on a P-III 550 with SDR GeForce). We did, however, notice the specular lighting, which allows metallic objects to glisten as light sources shine on them. The effect is decent, but it's so overused that everything from walls to sewers has a smooth sheen, detracting from the environment's realism.



Soldier of Fortune marks the return of the "mowing down groups of people with automatic weaponry" genre.



You're a tough mercenary, armed with a... microwave gun? Many weapons in *SoF* appear to be last minute additions.

We will give Raven props for its multiplayer content, as the game includes six gameplay options out of the box: Deathmatch, Team Deathmatch, Capture the Flag, Arsenal, Realistic, and Assassin. Assassin pits you against another player while you hunt each other down, and Arsenal forces you to kill people using every weapon in the game, one randomly assigned weapon at a time. When playing on the office LAN, we mostly stuck with Deathmatch, which was good fun overall but not enough to tear us away from *Unreal Tournament* and *Quake III*.

Soldier of Fortune doesn't offer anything in terms of gameplay that we haven't seen before. What it does offer is extremely graphic violence that comes across as a weak substitute for original game design, and ultimately ruins what could have been a promising title.

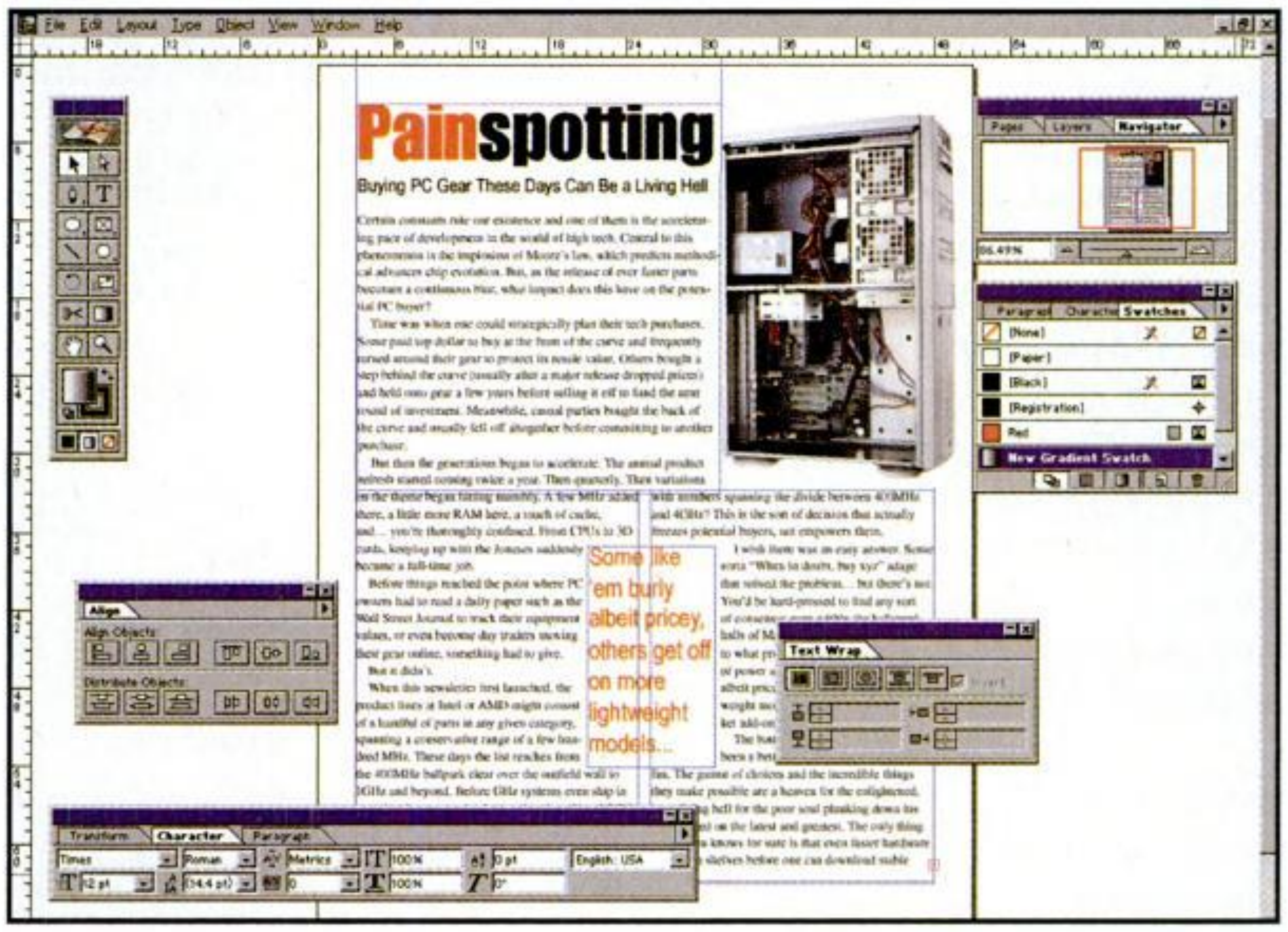
—Josh Norem

MAXIMUM PC VERDICT **5**

$42 I Raven Software
Buy www.SeeMeBuyMe.com
ID#015

Adobe InDesign

DON'T GET OUT OF THE XPRESS LANE

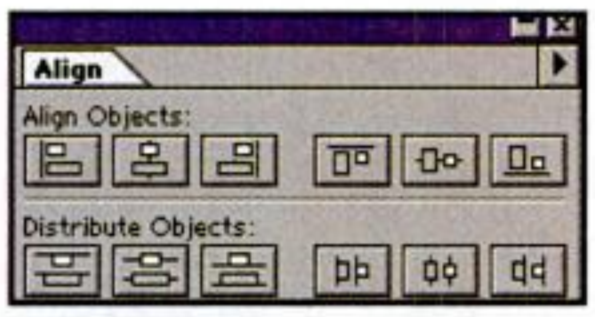

File Edit Layout Type Object View Window Help
Painspotting
Buying PC Gear These Days Can Be a Living Hell
Some like 'em burly albeit pricey, others get off on more lightweight models...
Align
Align Objects:
Distribute Objects:
Pages
Layers
Navigator
Paragraph
Character
Swatches
[None]
[Paper]
[Black]
[Registration]
Red
New Gradient Swatch
Text Wrap
Transform
Character
Paragraph
Times
Roman
Metrics
100%
0 pt
English: USA
12 pt
(14.4 pt)
0
100%
0°

InDesign by Adobe (**www.adobe.com**) was clearly conceived as a *QuarkXpress* killer, but it isn't one. Although it boasts a variety of useful features, *InDesign* doesn't offer enough for us to ditch *Xpress* just yet.

What *InDesign* does bring to the table, however, is a familiar (and powerful) interface from Adobe's most popular graphics apps. Adobe has been on a mission lately to unify the look and feel of all its products, and this package shows it. Upon launching *InDesign*, you'll have to look closely to know you're not using *Photoshop* or *Illustrator*. It's adorned with some bells and whistles, but simple familiarity may be the program's biggest asset.

If you've used *Xpress* before, you'll find that switching to *InDesign* is made easier by several features. The program lets you easily remap *Xpress'* command keys, and importing *Xpress* pages is a painless affair, though not a flawless one. Major projects transferred gracefully in our testing, but important details, including custom-built colors, were occasionally lost. Overall, the importing feature works well for smaller projects, but be prepared to spend time polishing up larger documents.

In general, larger documents are one of *InDesign's* weaknesses. Relying on expensive third-party support for most of the critical features that large documents require, *InDesign* is not the right choice for book publishers or creators of integrated documents.


Align
Align Objects:
Distribute Objects:

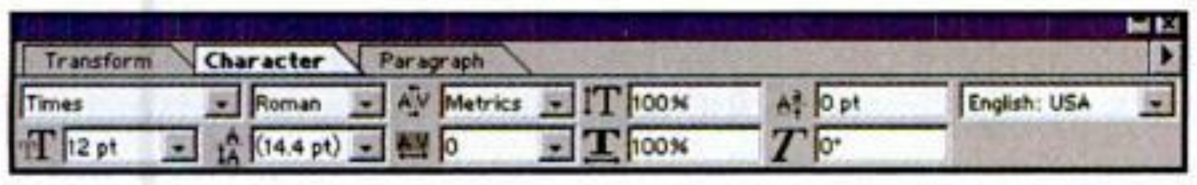
***InDesign's* Align palette proves incredibly useful—it's an idea that's long overdue in page layout software.**

Web publishers will also find *InDesign* wanting. The automatic export functions make it possible to convert pages into rudimentary web pages (complete with support for cascading style sheets), but testing the results with some *Maximum PC* pages proved fruitless—full re-coding was needed for all but the simplest of pages. Still, *InDesign's* efforts are promising for future revs of the app.

Regular users of Adobe's graphics apps will feel right at home with *InDesign's* pagination software.

Not surprisingly, *InDesign's* core competency lies in working with print. The program's type controls are a typographer's dream come true, allowing both manual and automatic control of even the subtlest nuances. We also liked the trapping schema, which delivered perfect borders on overlapping colors every time. This problem plagues even experienced *Xpress* users, but *InDesign's* intelligent implementation eliminates the issue.

InDesign is also exceptionally PDF-friendly—guess which company makes *Acrobat* PDF software?—but it's far less forgiving in the realm of printers. *InDesign* simply won't be seen gallivanting with anything less than a PostScript Level 2 printer. We had to convert projects to—you guessed it—PDF format before outputting to a color inkjet.


Transform
Character
Paragraph
Times
Roman
Metrics
100%
0 pt
English: USA
12 pt
(14.4 pt)
0
100%
0°

All of *InDesign's* basic tools are located in a palette that is reminiscent of *QuarkXpress'*... but oddly different.

While it does play nice with Adobe's own PDF format, *InDesign* has problems sharing with other Adobe apps. Importing is no problem—in fact, *InDesign* imports *Photoshop* files in their native format and even converts clipping paths to bezier-based frames. But it's a different story going the other way, as elements of an *InDesign* project cannot be exported into Adobe's own graphics apps.

With all of the interface and tool integration that Adobe's trying, we wish the company would take the plunge and create a one-stop solution for page designers, with full *Photoshop* and *Illustrator* capabilities built in, so multiple resource-hogging apps wouldn't need to fight for our precious memory. Adobe says it's concerned about "bloated" software, but given the shared code-base at this point, we're not buying it.

Ultimately, *InDesign* is a better-than-average first pass. Strong tool sets and capable implementation make it a useful option, but for now, we'll stick with *Xpress*.

—Brad Dosland

PLUSES
- Familiar interface
- Excellent type and trapping tools
- Plays well with *Photoshop*

MINUSES
- Doesn't share well with other Adobe apps
- Weak large document support
- Strict PostScript requirements
- Mixed web support

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Masterful CD Mastering

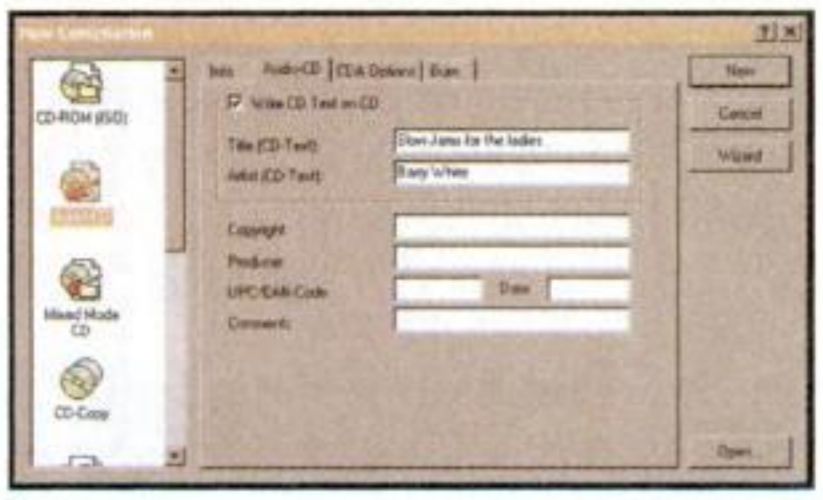
SOFTWARE TO FULFILL THAT BURNING DESIRE

You could use the software that came with your new CD-R drive, but why settle for that bundled junk when better options are available? The software you use to record CDs isn't just a middleman—it determines the quality of the recording, how fast you can create CDs, whether you can overburn a CD, and your ability to accurately duplicate games (for backup purposes only, of course). Buying a CD-R drive is only half the battle; you also need to enlist the right software for your CD mastering needs.

Nero Burning ROM

Nero by Ahead (**www.ahead.de**) is the best-kept secret in the CD mastering world, combining extreme levels of customization with blistering speed. While it's not the most user-friendly product available, *Nero* is simple enough for beginners and packs enough advanced options to satisfy a hardcore audiophile.

CD creation with *Nero* begins with a handy wizard that provides options for burning eight types of CDs. Everything from ISO CD-ROMs to videodiscs can be created in *Nero*, including combo ISO/UDF discs. After selecting the type of disc you wish to create, you're greeted with a litany of options ranging from relaxing ISO restrictions (allowing deeper filepaths and longer file names) to selecting the maximum size of files to be cached during CD creation. The range of advanced options is impressive, but don't fret if you don't know the difference between ISO level 1 and 2—right-clicking on each setting brings up a detailed explanation in a separate window.



Nero **offers supreme customization of the recording process, although for audio CDs you have to input all information by hand.**

One of *Nero*'s most advanced features enables you to overburn CDs, overriding the standard 650-to-700MB size restrictions of CD media. *Nero* will analyze your media, tell you how much data can fit on it, and let you set the upper limit for the amount of data to be recorded. If you try to pack too much data onto a CD, *Nero* will warn you that the overburn can't be completed. In testing, we were able to successfully burn up to 656MB onto a 650MB disc. Our only complaint with this feature—and with the software in general—is that it's tough to judge how many megabytes you're adding to a disc, because there's no realtime numerical indicator.

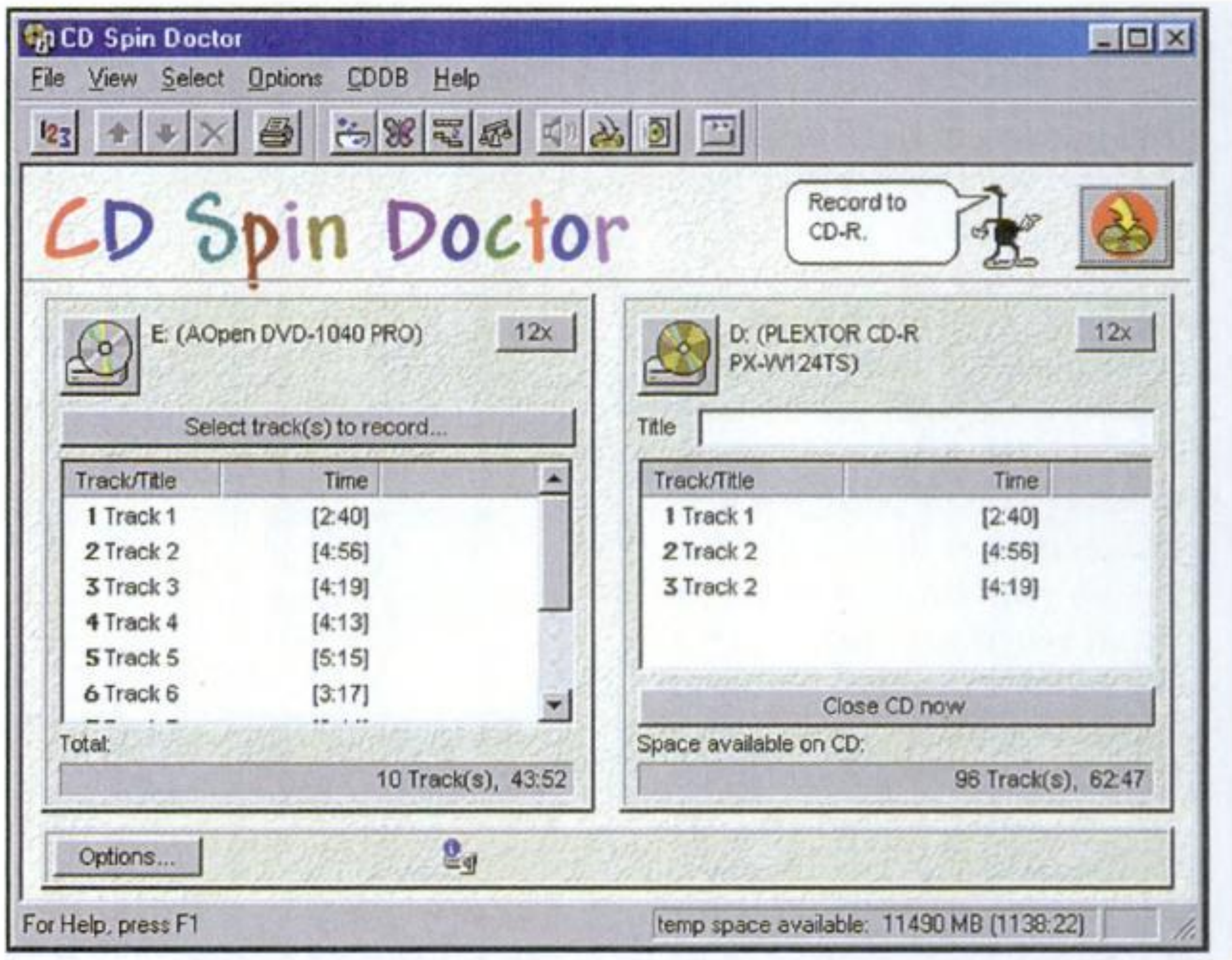
For audio duties, *Nero* can rip music CDs to WAV with ease, and convert files to MP3 at rates of up to 320kbps, though the full version lets you encode only 30 songs. No-holds-barred-encoding costs an extra $15. The only problem with using *Nero* to make music CDs is its inability to access CD track info via the CDDB or any other means; you'll have to type in the names of extracted audio files, or they'll simply be saved as Track 1, Track 2, etc.

As icing on the cake, *Nero* also lets you backup your entire hard drive to CD. The process doesn't use any compression, however, so be prepared to expend mucho media if your drive is larger than a few gigs.

Easy CD Creator 4.0

Adaptec (**www.adaptec.com**) is the 800-pound gorilla of the CD mastering world—*Easy CD Creator* is bundled with practically every CD-R sold. The justification for its popularity is enforced in the 4.0 version. The package is extremely easy to use, allowing you to quickly create everything from audio CDs to video postcards.

Version 4.0 includes a host of changes designed to guide newbies, including a new front-end wizard that helps you select which program to use, and an annoying animated character named "CD Guide" that's



Track/Title	Time
1 Track 1	[2:40]
2 Track 2	[4:56]
3 Track 3	[4:19]
4 Track 4	[4:13]
5 Track 5	[5:15]
6 Track 6	[3:17]

Total: 10 Track(s), 43:52

Track/Title	Time
1 Track 1	[2:40]
2 Track 2	[4:56]
3 Track 2	[4:19]

Space available on CD: 96 Track(s), 62:47

temp space available: 11490 MB (1138:22)

***Easy CD Creator's* CD Spin Doctor now supports MP3 file formats, but if you want to encode songs, you're limited to a paltry 56kbps.**

NERO PLUSES
- Tons of options
- Breakneck speed
- MP3 encoding
- Overburning

MINUSES
- No Internet capability
- No software bundle

ADAPTEC PLUSES
- Software for every occasion
- Intuitive interface
- Overburn support
- Web-enabled

MINUSES
- CD Guide is annoying
- 56kbps MP3 encoding

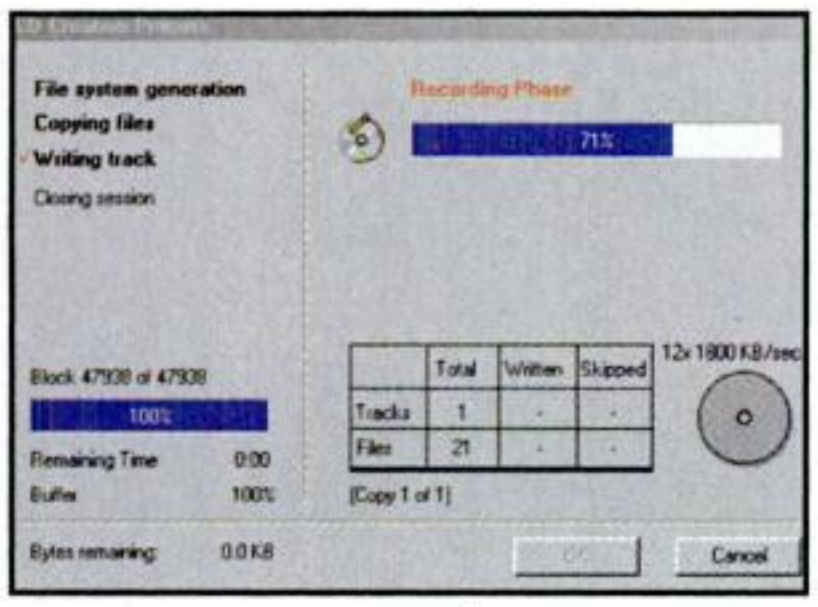
GEAR SUITE PLUSES
- WebGrabber is cool

MINUSES
- Wack Interface
- Light on functionality
- No MP3 support
- No web support

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

always showing up to offer helpful hints. Internet connectivity has been beefed up, so updating the program and obtaining CD information from the CDDB are now hands-off affairs. Adaptec has made some engine improvements as well. A fine-tuned caching scheme means *Creator 4.0* offers quicker burning times compared to the 3.5 version; our testing showed an improvement of more than four minutes in data CD creation times.

CD creation for both audio and data CDs is still handled in a drag-and-drop fashion, and you can extract audio by right-clicking on tracks listed in a compilation. MP3 support is touted as one of the biggest improvements, but you're only allowed to encode at a measly 56kbps.


File system generation
Copying files
Writing track
Closing session
Recording Phase
71%
Block 47938 of 47938
100%
Remaining Time 0:00
Buffer 100%

	Total	Written	Skipped
Tracks	1	-	-
Files	21	-	-

12x 1800 KB/sec
[Copy 1 of 1]
Bytes remaining: 0.0 KB

***Easy CD Creator's* recording status screen makes it a snap to check the status of your disc.**

The CD Spin Doctor handles all audio functions, and lets you do everything from removing hiss and crackle to adding effects, such as a robot voice or concert hall reverb. Before you get too excited, be warned that the effects sound awful.

Another good-sounding-idea-gone-wrong is the Take Two hard disc backup program. We applaud the inclusion of recovery software, but backing up a 20GB drive onto 650MB CDs is like going back to the days when it took 20 floppy disks to install *Duke Nukem*. *Nero* is also guilty of this—we'd appreciate either an incremental backup program that records changes made since the last backup, or some compression for hard drive images.

Like *Nero*, *Easy CD Creator* allows overburning, and we achieved approximately the same 656MB burn as we did with *Nero*.

CD-R Suite

The *CD-R Suite* from Gear Software (**www.gearcdr.com**) is certainly odd-man-out in this roundup. Not only does it lack many of the features offered by the other packages we reviewed, it's also extremely behind-the-times in terms of functionality and drive support.

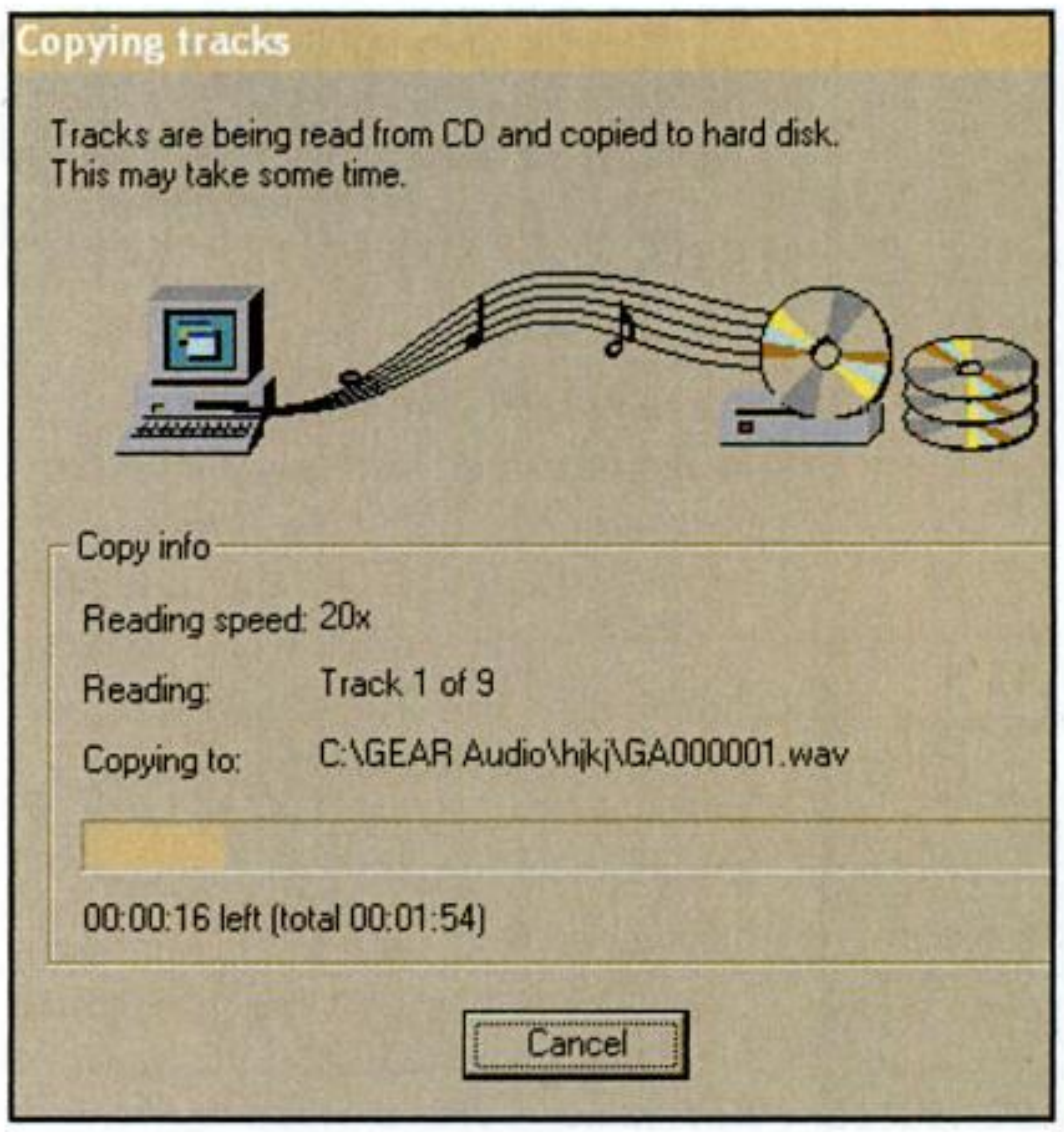
The Gear suite is made up of four modules: Gear Data, Gear Audio, WebGrabber, and Replicator. As the names suggest, each program performs a separate function, though they all share the same confusing layout and interface.

We attempted testing with our SCSI Plextor CD-R drive, but the system repeatedly froze when identifying our drive. No biggie, we thought, and switched to an ATAPI drive. The program recognized it, and we went to work on creating our first data CD. Half an hour later, we pulled out the manual hoping it might shed some light on how in the hell *CD-R Suite* works—it's that confusing. There's no wizard to guide you, and no indication of how many megs you've added to a disc. There are only cryptically labeled boxes that create confusion about what to do next.

The different modules' awkwardness is made worse by their inability to perform functions that are easily handled by other mastering programs. For example, *CD-R Suite* doesn't allow source-to-source copying; instead, it forces you to burn an image to your hard drive before creating a new CD. While this is a more reliable method than on-the-fly duplication, it requires gobs of hard drive space and takes a lot longer.

The audio program is hindered by a lack of support for anything but Redbook audio files—MP3 and CDA files are simply ignored. And when creating audio CDs, you're forced to save the audio files to your hard drive before burning them to a CD.

The saving grace of this suite is WebGrabber, which allows you to download entire web sites onto your hard drive. You can then look at the sites from your hard drive, or burn them to disc and take them with you. Unfortunately, WebGrabber pulls everything from the site and drops it onto your hard drive without any semblance of organization. You have to root around for the proper index file if you want to see the home page with all images intact.


Copying tracks
Tracks are being read from CD and copied to hard disk.
This may take some time.
Copy info
Reading speed: 20x
Reading: Track 1 of 9
Copying to: C:\GEAR Audio\hjkj\GA000001.wav
00:00:16 left (total 00:01:54)

Gear *CD-R Suite* doesn't allow source-to-source copying, so every CD has to be cached to the hard drive first. As the screenshot notes, "This may take some time."

The Final Word

In this group, *Easy CD Creator* is the only app that stands out as a true Jack-of-all-CD-mastering-trades. Quite simply, you can do more with this one than with both of the other programs combined, and you can do it with less trouble. *Nero* is a close second, offering more mastering options than any other program on the market. It's less friendly than *Easy CD Creator*, but if you're a power-user who rarely makes audio CDs, *Nero* is for you. *CD-R Suite* is, in fact, not sweet at all. Its WebGrabber function is cool, but the small number of other programs it includes are too confusing and feature-poor to garner our approval at this time.

—Josh Norem

AHEAD NERO 8

$70 | Ahead Software
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0617

EASY CD CREATOR 4.0 9

$90 | Adaptec
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0618

GEAR CD-R SUITE 3

$90 | Gear Software
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0619

Copyright material

Image Archivists

FAST FLIPPING THROUGH THUMBNAILS IS FUN, FUN, FUN

ACDSEE

PLUSES

- Fast thumbnail generation
- Nice image-tweaking options
- Arrow control through thumbnails

MINUSES

- Relatively expensive
- Poor imaging peripheral support

EXPLORER

PLUSES

- Great imaging peripheral support
- Nice price
- Friendly interface

MINUSES

- Thumbnail generation is painfully slow
- No arrow navigation through thumbnails

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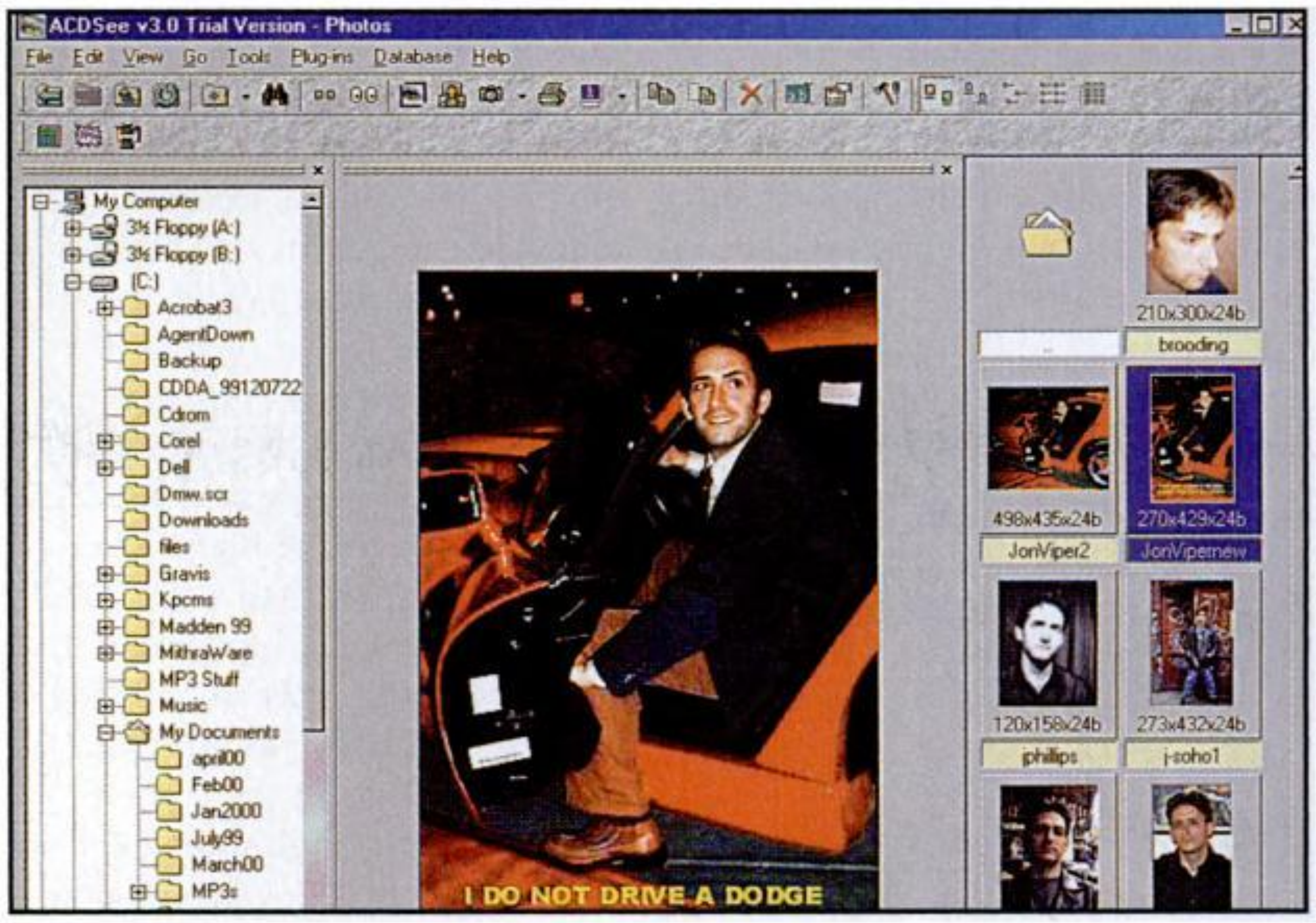
mpccp.com

Run a find on your hard drive for image files, then step away from the computer. See the wave of digital debris crashing through the window? That's the sum total of your relentless image collecting. The photolog of your trip to Oshkosh? It can go. The fruits of your forays into alt.binaries.nude.celebrities? It should be thinned from 1GB to 10MB—because, really, Jessica Biel only posed for *one* photo shoot, and no matter how many times you hit download, you're not going to see anything new.

You need a high-powered image viewer, son, a format-agnostic app that can quickly create thumbnail directories of all the pics on your hard drive and let you view, move, and delete image files in a flash. Here, we review two feature-laden image-cataloging apps.

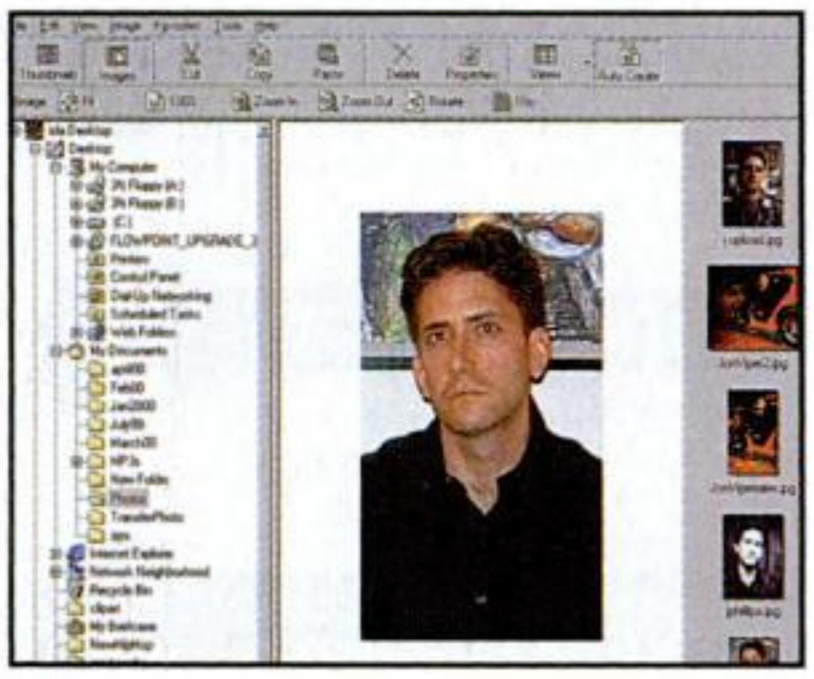


When chewing through an image folder, *ACDSee* spits out thumbnails like a woodchipper.

ACDSee 3.0

Like every member of its software brethren, *ACDSee's* interface is essentially broken into three panes: One shows your hard drive directory structure á la Windows *Explorer*, another shows thumbnails of all the files sitting in a selected folder, and a third shows a preview of a selected file. Right-click on an *ACDSee* thumbnail and up springs a grab bag of options—copy, move, delete, and rename are standard but invaluable. The option menu can also send you to a file conversion utility, as well as a rudimentary photo-enhancing applet that's as good as any software that might come with a scanner or digital camera. Thumbnail size can be adjusted by vertical and horizontal sliders, and if you don't want to view a folder's contents in thumbnail mode, you can view it as a list of filenames that displays the file size, pixel dimensions, and color properties.

Speed is a necessity when it comes to generating thumbnails, and *ACDSee* burns rubber through plump image folders. In fact, the software took only 78 seconds to create 1,086 thumbnails for 102MB worth of images. *ACDSee* also caches thumbnails, so there's no need to regenerate them every time you select an oft-visited folder. Finally, *ACDSee* (**www.acdsystems.com**) offers plug-in support for Kodak digital cameras, a contact sheet generator, and an HTML photo album generator.



While digital camera-friendly, Ixla *Explorer* is too slow to thin out large image herds.

Ixla Explorer

Feature for feature, *ACDSee* and Ixla's *Explorer* (**www.ixla.com**) are nearly mirror images of one another, but *Explorer* is booty-slow when it comes to thumbnail generation. Our 1,086-file test folder took 270 seconds to complete—and that was at the faster thumbnail-generation setting, which supposedly creates lower-res thumbnails. *Explorer* comes with preset defaults for small, medium, and large thumbnails. We ran our thumbnail generation test using medium-size thumbnails, but size really doesn't seem to matter when it comes to *Explorer's* overall speed. We did like the fact that *Explorer* caches thumbnails, and the app's large thumbnails are of a much higher quality than *ACDSee's* largest thumbnails. On the flipside, *ACDSee* allows you to peel through thumbnails with your keyboard arrows—*Explorer* doesn't. This may sound like a trivial complaint, but just wait until you begin using *Explorer* in earnest.

Nonetheless, *Explorer* is relatively cheap, and it supports an immense number of digital cameras and imaging devices out of the box. It can be your friendly companion as you explore the world of digital imaging, but it's not the best utility for thinning out gigantic file collections.

—Jon Phillips

ACDSEE **9**

$50 download; $60 CD
ACD Systems
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0620

EXPLORER **7**

$30 | Ixla
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#0621

in README files. Bad, Ontrack! Bad!

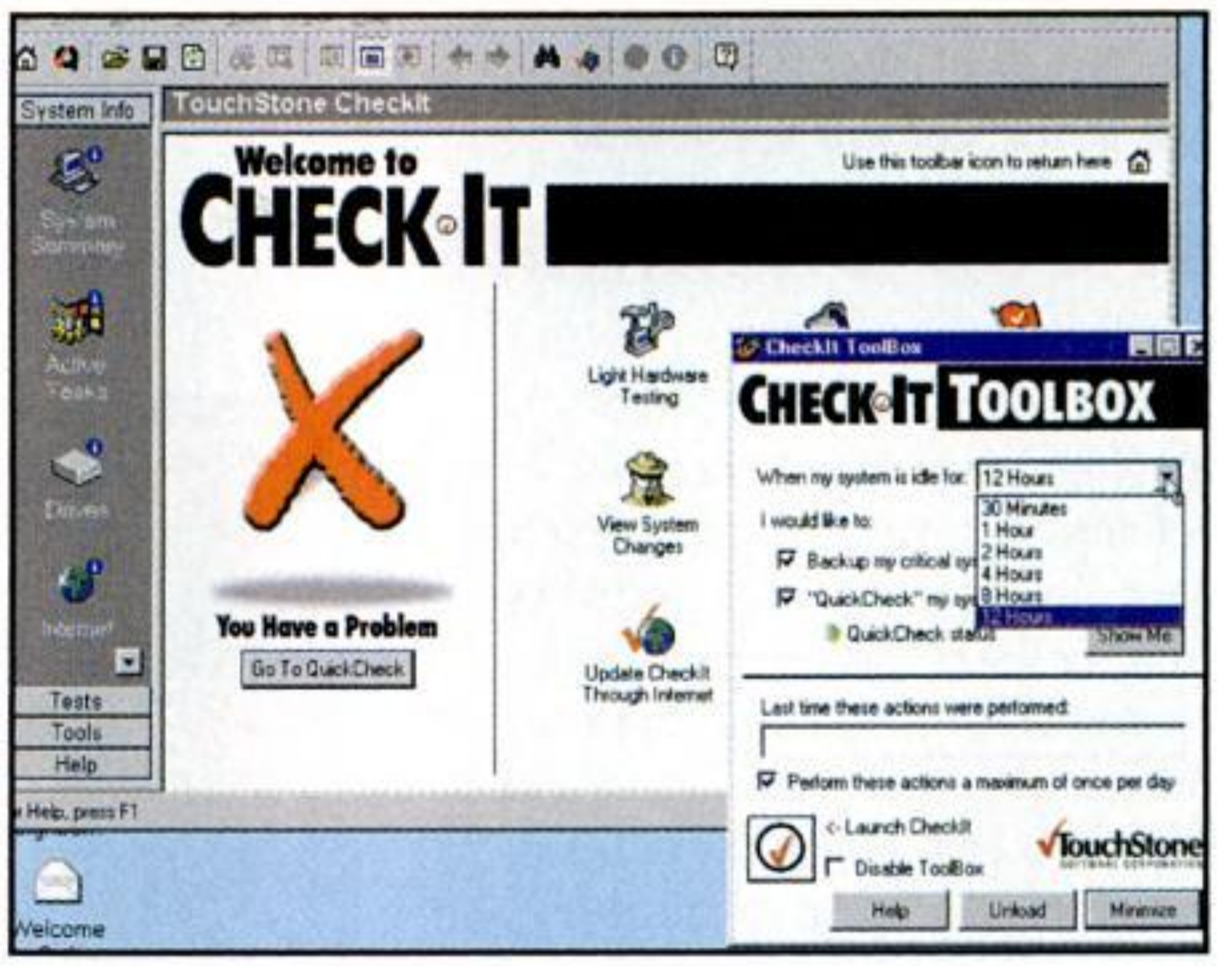
This snafu mars what would otherwise have been an excellent bonus: a "lite" version of Ontrack's *EasyRecovery* software. Similar to PowerQuest's *Lost and Found*, *EasyRecovery* boots the computer from a floppy disk and completely reconstructs a damaged hard disk's directory listings.

On balance, we'd have to say that *Norton* and *McAfee* offer products better designed to work with Windows. In spite of this, the *Fix-It* interface seems closer to what most users want.

WinCheckIt v6.5

If you're looking for first-rate system diagnostics and guidance in solving Windows configuration problems, Touchstone Software's *WinCheckIt* (**touchstonesoftware.com**) will do the trick. It lacks the disk repair and Registry optimization tools found in other utility suites, but offers excellent real-time troubleshooting wizards and diagnostic tools. We were impressed with the intuitive interface, the diligence of the diagnostic tests, and the interactive troubleshooting wizards that were actually useful—not to mention the program's glitch-free performance.

The star of the show is QuickCheck, which performs a diagnostic checkup of your PC that's actually more thorough than the "complete" diagnostics offered by many competing packages. If your PC is having problems, the interactive troubleshooter is actually helpful. It even contains direct links to the manufacturer's web sites and helps you create an e-mail message for a Tech Support rep.


TouchStone CheckIt
System Info
System Summary
Active Tasks
Drives
Internet
Tests
Tools
Help
Welcome to CHECK IT
Use this toolbar icon to return here
You Have a Problem
Go To QuickCheck
Light Hardware Testing
View System Changes
Update CheckIt Through Internet
CheckIt ToolBox
CHECK IT TOOLBOX
30 Minutes
1 Hour
2 Hours
4 Hours
8 Hours
12 Hours
Show Me
Help
Unload
Minimize
TouchStone
Help, press F1
Welcome

When my system is idle for: 12 Hours

I would like to:

☑ Backup my critical sy

☑ "QuickCheck" my sy

QuickCheck status

Last time these actions were performed:

☑ Perform these actions a maximum of once per day

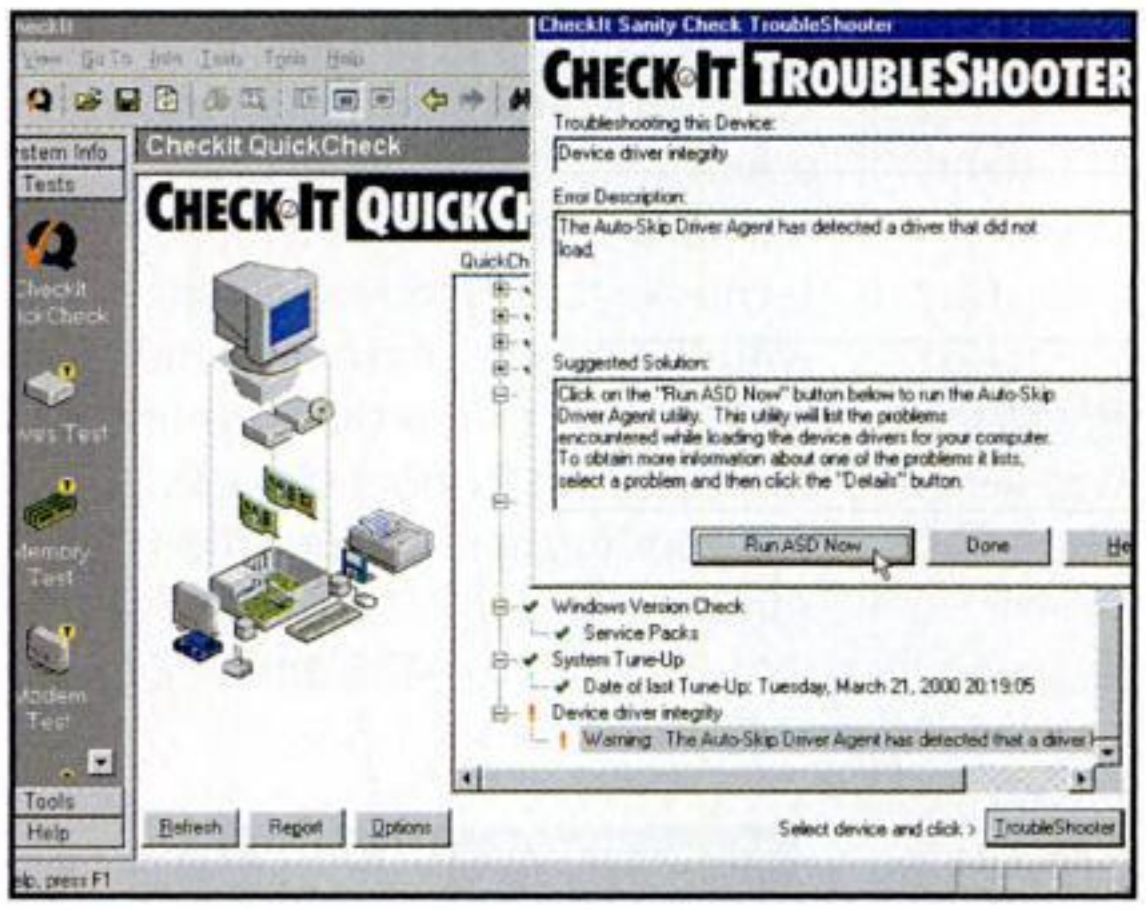
<- Launch CheckIt

☐ Disable ToolBox

WinCheckIt's easy-to-use QuickCheck provides access to diagnostic information screens and individual system component tests, and offers an informative troubleshooting database.

QuickCheck also offers a Sanity Check section, which advises you if your system files haven't been backed up, warns you if Defrag and ScanDisk haven't been run recently, and entreats you to install Service Pack updates and perform a System Tune Up. On our Windows 98 SE test computer, the Driver Integrity report informed us that the Windows 98 Auto-Skip Driver Agent had disabled a system driver. We clicked the "Run ASD" button on the report screen and discovered that Windows was no longer making calls to the computer's PNP BIOS. No wonder PC Card peripherals weren't being detected when we plugged them in! We re-enabled the "Calling a PNP BIOS" feature and this problem disappeared.

WinCheckIt offers thorough, component-by-component information screens, performance benchmarks, and advanced diagnostic tests. The diagnostic results of each test are linked to *WinCheckIt*'s informative troubleshooting wizards. If you have a high-end 19- or 21-inch monitor, you'll really appreciate the first-rate video calibration feature, which is patterned after Sonera's professional *DisplayMate* utility.


CheckIt Sanity Check TroubleShooter
CHECK IT TROUBLESHOOTER
CheckIt QuickCheck
CHECK IT QUICKC
System Info
Tests
QuickCheck
Drives Test
Memory Test
Modem Test
Tools
Help
Run ASD Now
Done
Refresh
Report
Options
TroubleShooter
Help, press F1

Troubleshooting this Device:
Device driver integrity

Error Description:
The Auto-Skip Driver Agent has detected a driver that did not load.

Suggested Solution:
Click on the "Run ASD Now" button below to run the Auto-Skip Driver Agent utility. This utility will list the problems encountered while loading the device drivers for your computer. To obtain more information about one of the problems it lists, select a problem and then click the "Details" button.

✓ Windows Version Check
  ✓ Service Packs
✓ System Tune-Up
  ✓ Date of last Tune-Up: Tuesday, March 21, 2000 20:19:05
! Device driver integrity
  ! Warning: The Auto-Skip Driver Agent has detected that a driver

Select device and click >

WinCheckIt's interactive troubleshooter beats Microsoft's limited Windows 98 wizards. Here, it detects a problem that Windows forgot to tell us about.

The bundled Command Antivirus package lets you scan on demand, with customized filepaths and automatic or interactive disinfection. The realtime virus interceptor is also on its toes. We liked the flexible Command antivirus interface better than the pared-down Trend antivirus scanner in *Fix-It Utilities 2000*, although both programs found the same number of viruses on our hard disk.

If you share your computer with other users, *WinCheckIt's* System Spy can tell you whether someone ran amuck with your PC while you were on vacation. You can pinpoint such system changes as additions and deletions in applications, and system DLL changes by date and time, making it easy to pinpoint when your PC was fiddled with. And *WinCheckit* diagnostics can be scheduled at intervals ranging from every 12 hours to every 30 minutes.

The Final Word

In this shootout, the blue ribbon goes to *WinCheckit*. Although it won't repair a corrupted hard disk or undelete lost files, it offers some of the best system diagnostics and non-invasive problem-solving support we've seen in a utility suite. *Fix-It Utilities* does a good job of mirroring the disk repair and antivirus features offered in other suites, and it uses much less hard drive space, but the bugs we encountered were enough to shake our confidence in this otherwise solid package.

—Lenny Bailes

FIX-IT UTILITIES 2000 **7**

$50 | Ontrack Systems, Inc.
Buy www.SeeMeBuyMe.com
877.751.7467 | ID#023

WINCHECKIT V 6.5 **9**

$50 | Touchstone Software
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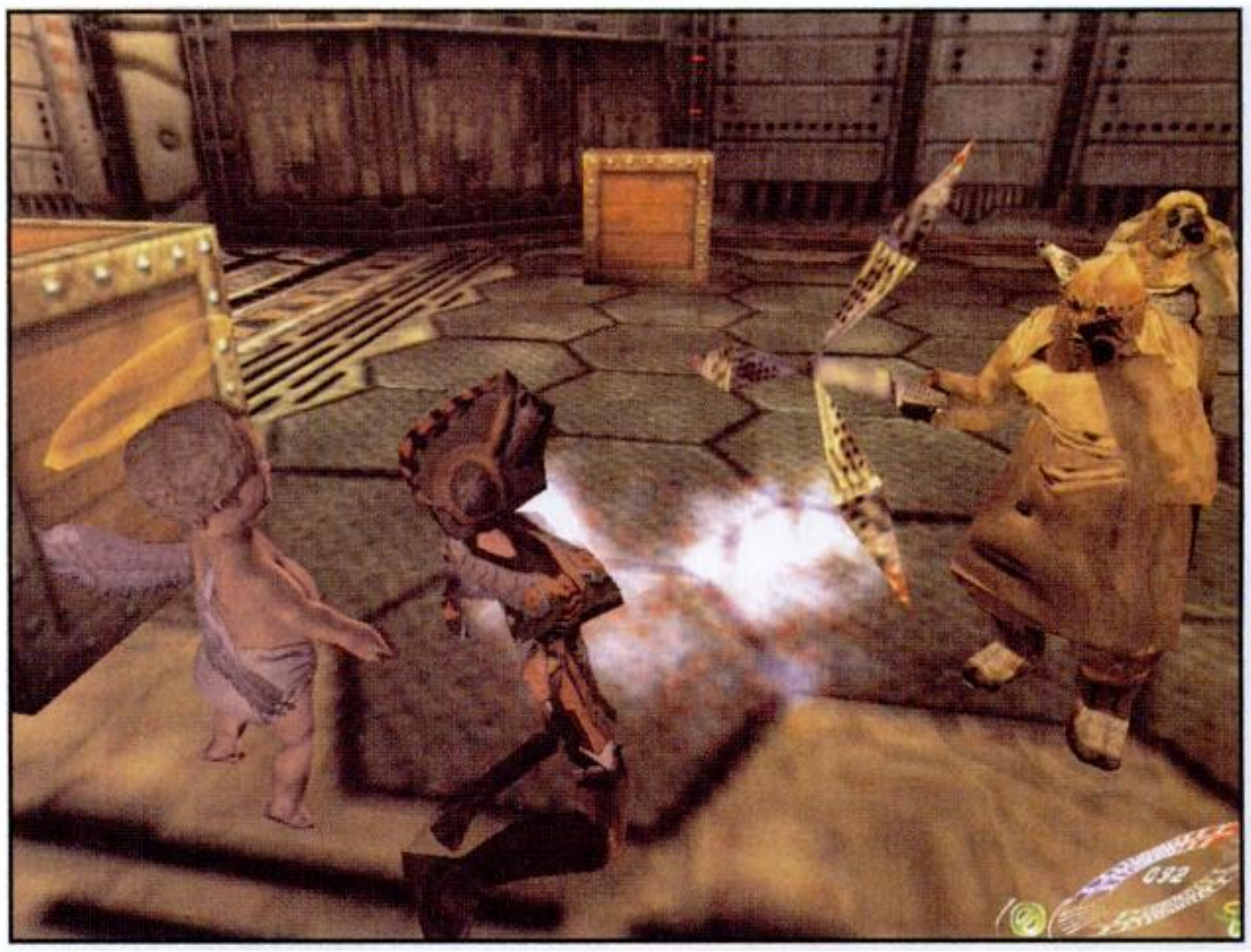
Messiah

BE GOD'S MINI-HITMAN



Messiah's possession and de-possession sequences are great fun to watch.

PLUSES
- Weird and interesting setup
- Sharp, scalable graphics with good frame rates

MINUSES
- Flying control is awkward
- Some of the jumping puzzles are too hard
- Jagged character shadows

THE SPECS

3D CARD SUPPORT	Direct 3D
3D SOUND SUPPORT	DirectSound
MULTIPLAYER	None

You have to hand it to Shiny: *Messiah* (**www.messiah.com**)is nothing if not original. Despite some slow spots and technical gaffes, it's a pretty good third-person game.

You crash-land into a standard Grim City of the Future wearing the body of a cop, but this is not your true form. Rather, as an angel named Bob, you've been sent by God to bring order to chaos. Diaper-clad Bob is a wee cherub, knee-high and fragile. He has no weapons and no fighting abilities. In fact, Bob's only real skill is the ability to possess others—but it's pretty much the only skill he needs.

Bob can possess the body of any living being in the game—once the intended victim turns his back, Bob just leaps right into his soul. Of course, Bob needs to inhabit different bodies for different reasons—scientists can operate equipment, radiation workers can enter contaminated areas, commanders can unlock doors, rats can squeeze through pipes—so *Messiah* includes a few dozen possessable beings. Bob assumes each character's abilities and weaknesses, though almost any character appears able to use any weapon.

Weapons are familiar but well-executed, particularly the flamethrower, the harpoon, and the "pak," which throws ice shards and provides the user with limited flight abilities. Hand-to-hand combat, including sneaking up and silently choking someone, is nicely integrated. The lingering problem, of course, is the alignment from the third-person perspective. It works OK in a firefight, but it's devilishly difficult to line up a shot in order to destroy an inanimate object.

"Body hopping," or jumping from one person to another as they try to kill you, is the best way to get a mob to kill itself.

Messiah's slight controls are also pretty awkward, making jumping puzzles amazingly annoying. Hopping from ledge to ledge, as Bob is required to do on some occasions, is totally frustrating, since ledges are placed precisely where you'll miss them the first several times you try. In general, making Bob fly is difficult, since his wings are useful for short leaps and coasting to the ground, but not for flight.

Technologically, *Messiah* is tight. We experienced no major crashes, but did discover a few glitches. For example, we couldn't get the audio running for the intro movie, though in-game positional sound was generally good. The 3D engine pushes a lot of polygons pretty effectively, and automatic scaling keeps frame rates high based on the power of your system. Just set the desired frame rate, and the engine gauges the available resources and scales the amount of polygons accordingly. Of course, this technology might not be necessary if the player models didn't contain such obscenely high polygon counts. According to the development team from Shiny, primary models are comprised of about 2,000 polygons that scale down to between 200 and 250 per character in crowd scenes, with surprisingly little image degradation. The polygon-scaling technology works well, but we still saw some floating textures, warped walls, and characters with misaligned joints.

Aside from the vexing jumping/flying element, the gameplay in *Messiah* is strong, mixing combat with logic. It's also very, very difficult, causing us to set a new record for "dying-and-reloading." *Messiah* is a weird, technologically innovative game with the bizarre sense of humor you would expect from the *Earthworm Jim* folks. And where else can you get your mission briefings from The Almighty?

—T. Liam McDonald

MAXIMUM PC VERDICT **8**
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Picture-perfect printers

FOTOMAT IS FOR AMATEURS

To realize the full potential of your digital camera, you need a photo printer. To find out who's got the goods, we rekindled the long-running rivalry between Epson and Hewlett-Packard, and added newcomer Sony for a three-way photo printer showdown. If you don't think a consumer-level printer can kick out prints that would fool Olan Mills, check out these bad mama-jammas.

THE SPECS
EPSON

HEAD	6-color CYMK, drop-on-demand, Micro Piezo 4-picoliter drop size
MAX PRINT RES	1440x720 dpi
RATED SPEEDS (photos in "fine" mode)	4" x 6": 48 secs 8" x 10": 1 min, 50 secs
PAPER TRAY CAPACITY	100 sheets/10 envelopes
INTERFACES	Parallel I USB
BUNDLE	EPSON *Film Factory* I Adobe *PhotoDeluxe* 3.1

THE SPECS
HEWLETT-PACKARD

HEAD	4-color CYMK, thermal drop-on-demand, PhotoRET III 5-picoliter drop size
MAX PRINT RES	2400x1200 dpi
RATED SPEEDS (photos in "best" mode)	4" x 6": 0.6ppm 8" x 10": 0.3ppm
PAPER TRAY CAPACITY	100 sheets/15 envelopes
INTERFACES	Parallel I USB
SOFTWARE DRIVERS	USB: Windows 98 Parallel: Windows 98, 95, NT 4.0
BUNDLE	HP Printing Software Adobe *Acrobat Reader*

Epson Stylus Photo 870

Three months ago, Epson (**www.epson.com**) blew us away with the image quality of its Stylus Scan 2500 Pro multifunction printer. We were hardly expecting *more* from its dedicated photo printer—but that's what we got. We're still picking our jaws up off the floor.

Most printers use a four-ink supply and thermal ink transfer. But Epson's Stylus Photo 870 comes to the table with a six-ink supply. Why does this matter? Four-ink printers use four core colors (cyan, yellow, magenta, and black) to reproduce the millions of color blends and tones found in traditional photographs. Six-color printers add light cyan and light magenta channels to the standard CYMK palette, making transitions between gradients, colors, and tones smoother and more natural. These added colors may not seem like much, but together, they help produce 50 percent more color possibilities than what's offered by four-ink printers. The difference is amazing, particularly in fleshtones.

All three printers have USB support, but only the Stylus Photo 870 has a six-ink supply for unbelievable color and clarity.

An additional boon is Epson's Micro Piezo technology, which delivers breathtaking image reproduction. The other printers in this roundup use thermal ink transfer: The ink is heated to a boiling point at which it expands; it's then literally spit onto the paper. Thermal printing suffers from two inherent problems. First, due to a requisite cooling-down period, not all of the ink nozzles can be used at the same time, lengthening the time it takes to complete a print job. Second, spattering and spotting can occur when ink is spit out of the nozzles (this is especially evident in text prints on white paper).

Micro Piezo technology side-steps these issues by using a special material in the print heads that expands when an electrical current is passed through it. This puts pressure on the ink supply, which releases a precise amount of ink every time. All this technology results in un-frigging-believable prints that you could frame and call photographs. Nobody would know the difference. Seriously.

SmartMedia and CompactFlash slots let you print on the PhotoSmart P1100 without even turning on your computer.

The only problem we had with the Epson was that it didn't reproduce low-resolution pictures very well, resulting in spotting and over-saturation of color in dark areas. And with digital camera correction enabled, the printer tried to "correct" the low-quality images by anti-aliasing trouble areas, resulting in overall fuzziness. The 870 is definitely geared toward a prosumer audience that can afford fat digital cameras capable of obscene resolutions. You've been warned.

Hewlett-Packard Photosmart P1100

HP (**www.pandi.hp.com**) gets big points for functionality and ingenuity with its Photosmart P1100. But let's get one thing clear right off the bat: Its image quality is not as good as the Epson's, period. That said, it's still pretty damned good.

HP's printer uses PhotoRET III, a color layering technology that allows up to 29 individual ink drops in a 5-picoliter drop of ink. This layering technology produces superior color accuracy and better control over shades and tones. The Photosmart also offers a whopping 2400x1200 dpi physical print resolution. But sadly, all of this technology is limited by a four-ink CYMK supply and thermal transfer technology (see above for a description of its shortcomings).

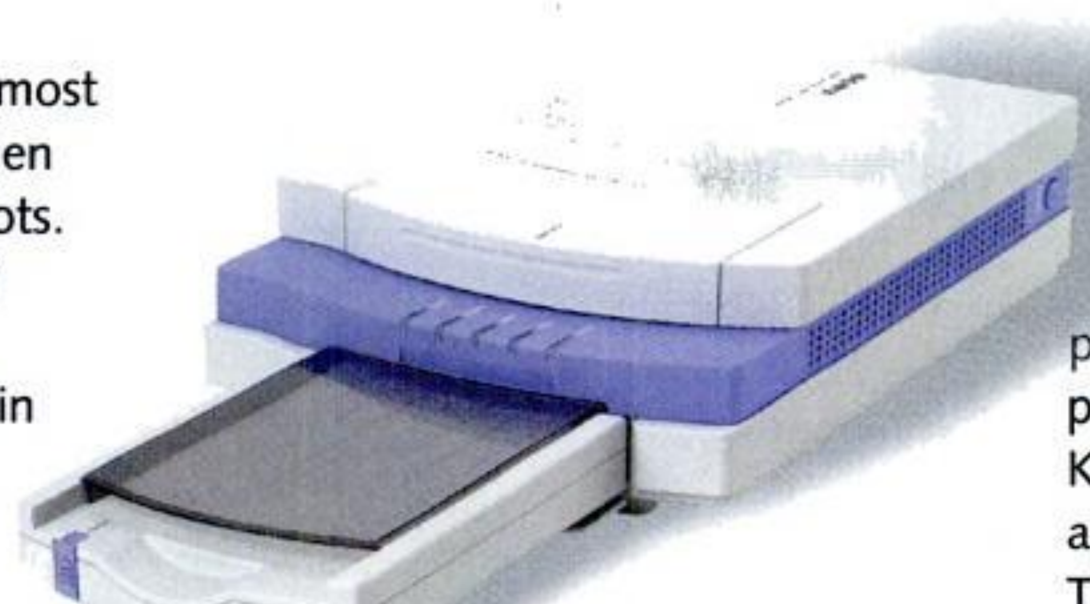
The HP was, however, the most forgiving of all the printers when reproducing low-resolution shots. Testing on our real-world staff pictures (taken with a Kodak DC-260 at 768x512) resulted in flawless reproductions; the pics escaped the awful pixelization introduced by both the Epson and the Sony. The shots were smooth and clear, though a tad faded.

Importing pics from a digital camera is clearly this printer's forte; it offers slots for both CompactFlash cards and SmartMedia cards, so you can print pictures directly from your digital camera's memory card—no computer interface necessary. Using the printer's front-panel controls, you can choose print size, type of paper, and which pictures on the card you want to print. Add to this a double-sided printing module and two trays—one for regular printing and one designed for photo media (such as 4x6-inch postcards)—and the Photosmart becomes a real contender.

Sony UP-DP10 Digital Photo Printer

Sony (**www.sonyprofessional.com**) designed the UP-DP10 to do one thing and one thing only: print high-quality photo prints at either a 2:3 or a 3:4 aspect ratio. It isn't designed for text, line art, or *PowerPoint* presentations, and we kept this in mind when benchmarking the unit. Unfortunately, with only one purpose in life, the UP-DP10 paled next to its competitors, which actually printed better photos in some situations.

Printing pics with the Sony is a breeze. You place your photo paper into a small tray that slides into the unit for easy loading and unloading. The paper even comes with handy perforated edges that you can break off after printing, for perfectly borderless photos.



It's small and it's pretty, but the ink ribbon goes fast and the UP-DP10 is not forgiving to pics taken with a digital camera.

The UP-DP10 uses an ingenious ink ribbon-cartridge technology called dye sublimation, which opens a sheet of transparent material over the blank photo paper and, in a series of passes, thermally burns the image through the sheet to the paper underneath. Each pass adds a different color of the color palette, as well as a lamination material that protects photographs.

Our biggest beef? The Sony uses a wimpy three-color print head (cyan, magenta, and yellow). While this allows for millions of colors, it also means that the color black is always a composite of the other colors. When we printed photos with a lot of shading, they always appeared washed out. And with a dpi of just 295, only high-quality photos came out well. Plus, our ink ribbons were only good for twenty-five pics.

Don't get us wrong, the UP-DP10 printed beautiful pictures with accurate, vibrant color reproduction, especially with nature photography. But these were all high-resolution, professionally photographed images specifically designed to test print quality. When we printed pics snapped with our Kodak DC-260, we were appalled at the pixelization. This problem occurred even with high-resolution pics snapped with the Kodak—and these same high-res pics came out flawlessly on both of the other printers.

The Final Word

Epson takes the cake with stunning photo print quality, crisp text, and a price so right, it's spooky. HP gets props for being the trustworthy and dependable printer of the group. Its image quality is less spectacular than the Epson's, but it's got enough features to keep it from the ass-end of the pack. Sony, sadly, came to the party with a sleek printer that had potential, but was simply outclassed.

—Geoffrey Visgilio

EPSON STYLUS 870 **9**
$300 | Epson
Buy www.SeeMeBuyMe.com
877.751.7467 ID#0626

HEWLETT-PACKARD P1100 **8**
$500 | Hewlett-Packard
Buy www.SeeMeBuyMe.com
877.751.7467 ID#0627

SONY UP-DP10 DIGITAL **6**
$390 | Sony
Buy www.SeeMeBuyMe.com
877.751.7467 ID#0628

THE SPECS
SONY

HEAD
Dye sublimation thermal printing

MAX PRINT RES
295x295 dpi

RATED SPEEDS
4" x 6": 85 secs
8" x 10": NA

PAPER TRAY CAPACITY
25 sheets

INTERFACES
Parallel | USB

BUNDLE
None

EPSON
PLUSES
- 6-color ink supply
- Phenomenal-quality prints
- The price is right

MINUSES
- Doesn't print low-res pictures well
- Color runs low too quickly

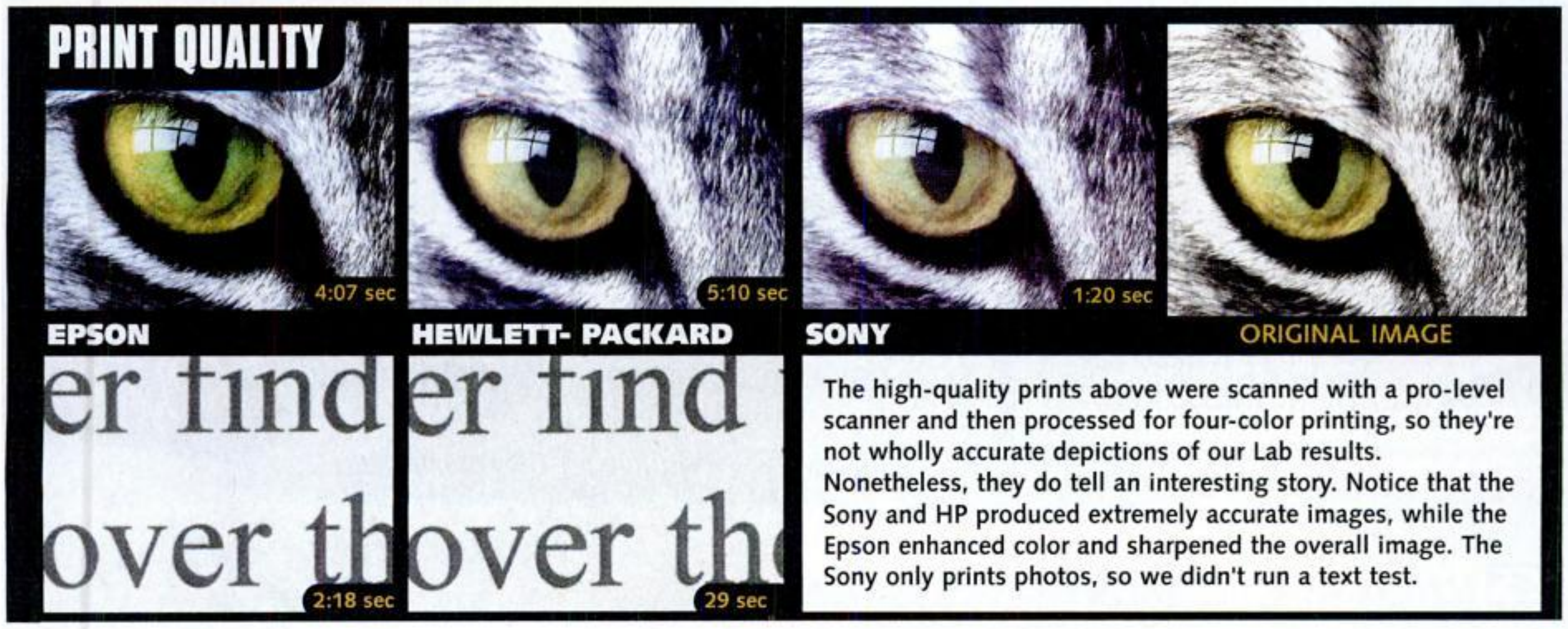
HP
PLUSES
- CompactFlash and SmartMedia card slots
- Double-sided print module
- Direct printing and front panel print size controls

MINUSES
- Pricey
- Print quality is secondary to the Epson

SONY
PLUSES
- Nice design, easy hookup
- Small footprint
- Special borderless paper is very cool

MINUSES
- Digital photos looked awful
- Photo ribbon is only good for twenty-five pics
- Pretty pricey for a one-trick pony

PRINT QUALITY



The high-quality prints above were scanned with a pro-level scanner and then processed for four-color printing, so they're not wholly accurate depictions of our Lab results. Nonetheless, they do tell an interesting story. Notice that the Sony and HP produced extremely accurate images, while the Epson enhanced color and sharpened the overall image. The Sony only prints photos, so we didn't run a text test.

Creative Nomad II

NEW MP3 PLAYER IS SLOTS-A-FUN

THE SPECS

DIMENSIONS	65mm W x 93mm H x 21mm D 88g without battery
CONNECTION TYPE	USB
BITRATE SUPPORTED	Variable Constant up to 320kbps

Since *Maximum PC* believes in real-world testing, there was only one way to test the performance of the Nomad II: We took it to Las Vegas. It was a tough assignment, but the Nomad II made the vacation… er, the *testing* a little easier to bear.

Like its predecessor, the Nomad II (**nomadworld.com**) includes an FM tuner and one-touch voice recording. New to this model are a backlit LCD, customizeable bass and treble settings, and "backphone" headphones that rest behind your head, not on it. And a remote control on the backphones' cable lets you control the device while it's secreted away in a pocket.

The Nomad II has good volume. Playback at the highest volume introduces some hiss and muffled highs, but at normal listening levels, everything from booming bass to screeching synthesizers sounds great.

Our biggest beef is with the *Nomad II Manager* software. It's rife with useless popup boxes that appear when the cursor rolls over just about anything. We used the time that it takes for songs to load onto the unit to brush up on our baccarat skills—you can't upload and browse through files simultaneously.

The Nomad II is available with either a 32MB or a 64MB SmartMedia card, or you can opt for a cheaper version with no memory—your best deal, since the cards can be found separately for $30 to $60 (for 16MB). We were a bit miffed by the lack of onboard memory, but this way, users aren't paying for memory that's wedded to one device.

We had fun in the Vegas sun with the Nomad II.

The Nomad II's biggest benefit is that it's firmware-upgradeable via the nomadworld.com web site, and slated to support all future codecs. If you already own SmartMedia cards, or know where to buy them for cheap, the $99 0MB version of the Nomad II is a pretty safe bet.

—*Kristen Shepos-Salvatore*

PLUSES

- No onboard memory
- Gets good-n-loud

MINUSES

- No onboard memory
- Software is painful to use

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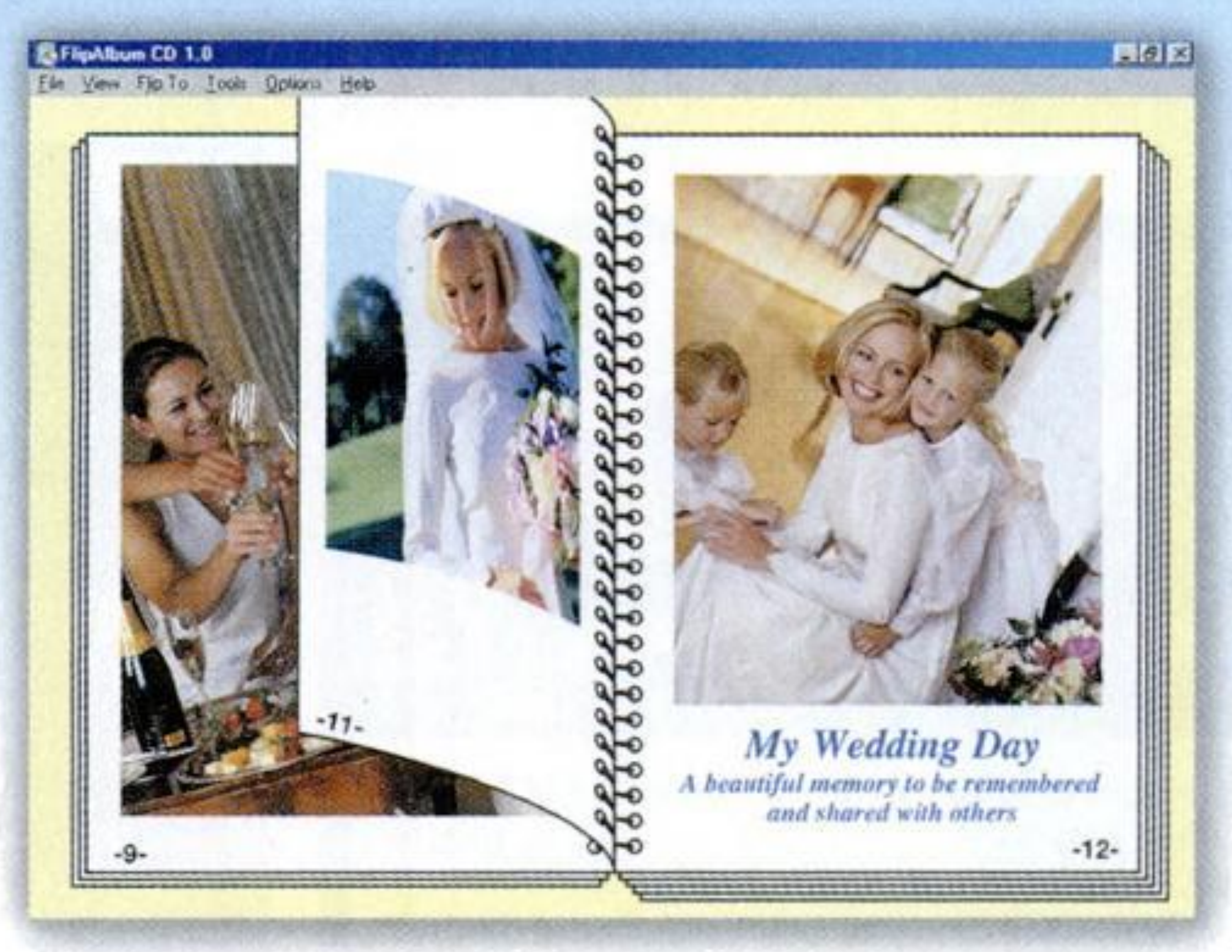
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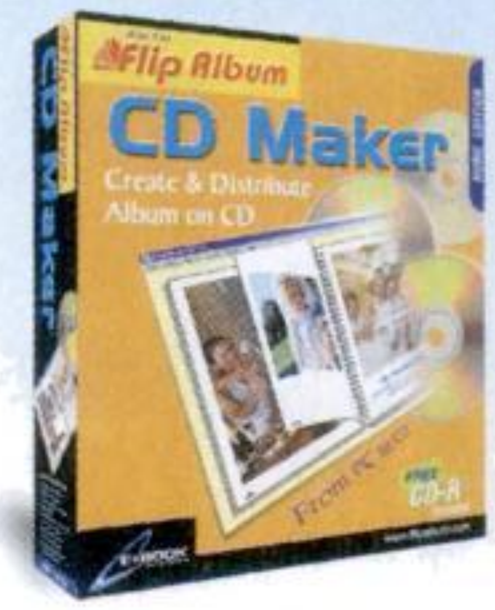

*requires a CD-RW drive for CD-R recording

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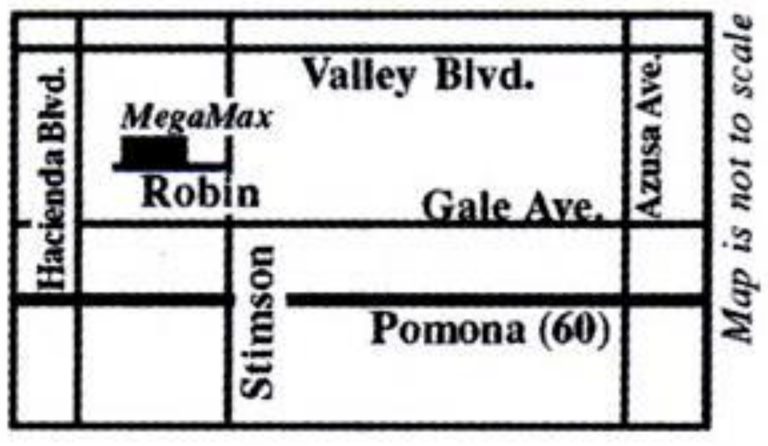

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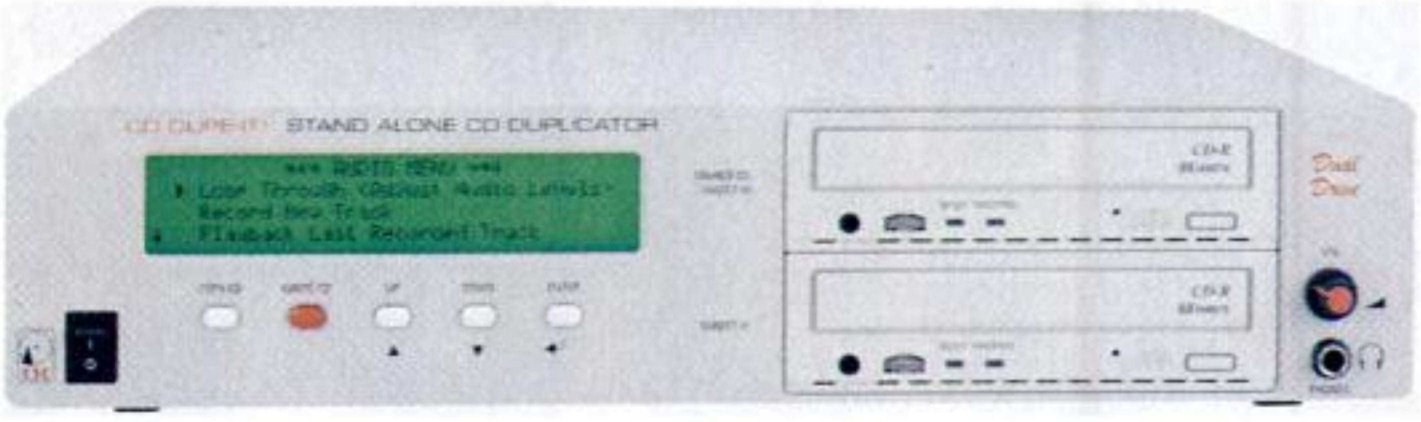

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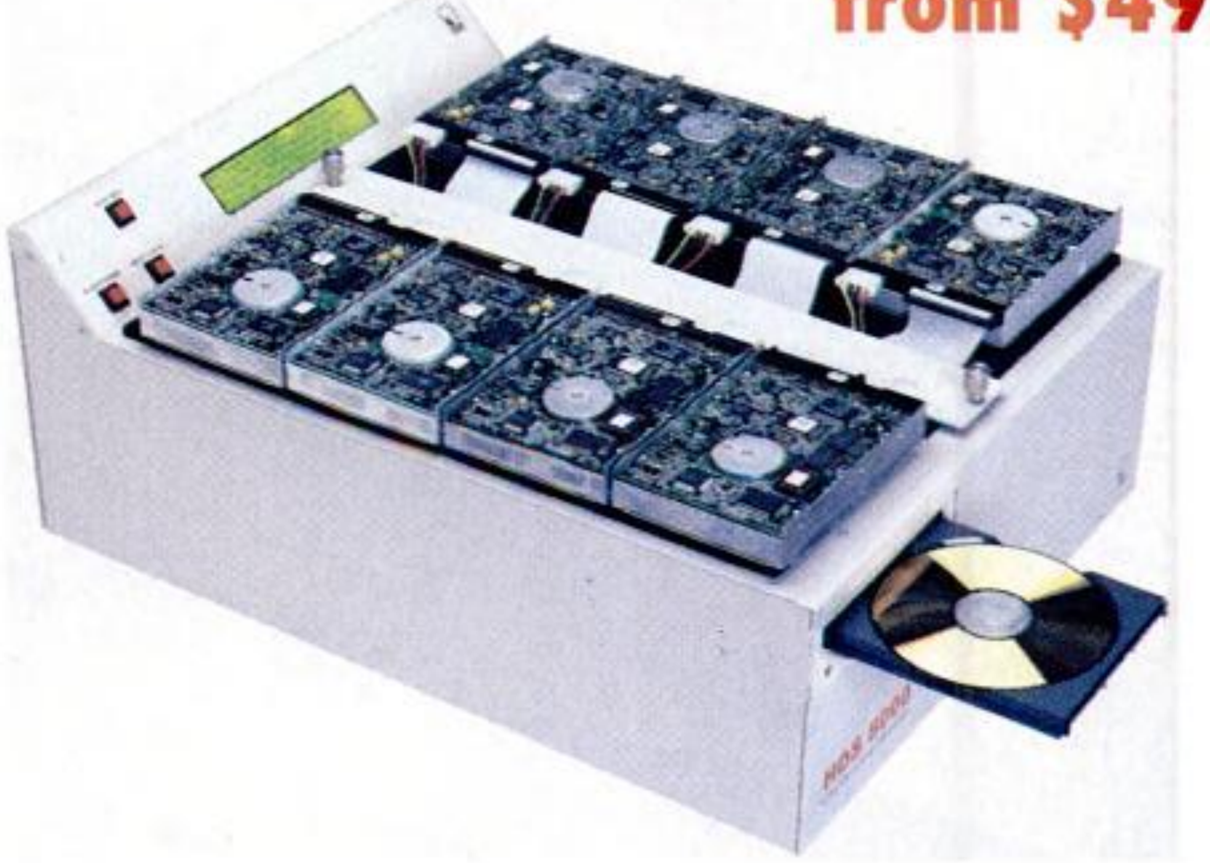

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Asus P5A-B	MB5711	ALi Aladdin V	512	384	3		Award			3	2	1	Baby AT	1 Yr.	$98	$157	$183	$143
EPoX EP-MVP3C2	MB5406	VIA Apollo MVP3	512	384	3		Award		UltraDMA/66	4	2	1	Baby AT	2 Yrs.	$82	$141	$167	$127
EPoX EP-MVP3G5	MB5405	VIA Apollo MVP3	2048	384	3		Award		UltraDMA/66	5	2	1	ATX	2 Yrs.	$106	$165	$191	$151
FIC PA-2013 (2MB Cache)	MB5214	VIA Apollo MVP3	2048	384	3		Award			4	2	1	ATX	1 Yr.	$103	$162	$188	$148
FIC VA-503+	MB5211	VIA Apollo MVP3	1024	512	2	4	Award			3	3	1	Baby AT	1 Yr.	$76	$135	$161	$121
Shuttle HOT-591P	MB5611	VIA Apollo MVP3	512	256	2	2	Award			3	3	1	Baby AT	1 Yr.	$77	$136	$162	$122
Tyan S1590S Trinity 100AT	MB5006	VIA Apollo MVP3	1024	384	3	2	Award			4	4	1	Mini AT	3 Yrs.	$95	$154	$180	$140
Tyan S1598 Trinity ATX	MB5008	VIA Apollo MVP3	2048	384	3		Award		UltraDMA/66	5	2	1	ATX	3 Yrs.	$121	$180	$206	$166

Slot A	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Bus Frequency	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD Athlon™ 650MHz	w/AMD Athlon 700MHz	w/AMD Athlon 750MHz	w/AMD Athlon 800MHz	w/AMD Athlon 850MHz	w/AMD Athlon 900MHz	w/AMD Athlon 950MHz	w/AMD Athlon 1000MHz
ABIT KA7	MB7501	VIA Apollo KX133	2048	4	Award	200/133	UltraDMA/66	6	1	1	ATX	1 Yr.	$179	$369	$404	$464	$559	$689	$849	$1049	$1469
AMI Megathon	MB7301	AMD-751 / VIA 686A	768	3	Award	100	UltraDMA/66	5	1	1	ATX	1 Yr.	$165	$355	$390	$450	$545	$675	$835	$1035	$1455
Asus K7M	MB7701	AMD-751 / VIA 686A	768	3	Award	100/120/133	UltraDMA/66	5	1	1	ATX	1 Yr.	$179	$369	$404	$464	$559	$689	$849	$1049	$1469
Asus K7V	MB7703	VIA Apollo KX133	1536	3	Award	200/133	UltraDMA/66	5		1	ATX	1 Yr.	$189	$379	$414	$474	$569	$699	$859	$1059	$1479
EPoX EP-7KXA	MB7850	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	5	1	1	ATX	2 Yrs.	$139	$329	$364	$424	$519	$649	$809	$1009	$1429
FIC SD11	MB7401	AMD-751 / VIA 686A	768	3	Award	100	UltraDMA/66	5	1	1	ATX	1 Yr.	$109	$299	$334	$394	$489	$619	$779	$979	$1399
Microstar K7 Pro	MB7202	AMD-750	768	3	Award	100	UltraDMA/66	6	1	1	ATX	1 Yr.	$154	$344	$379	$439	$534	$664	$824	$1024	$1444
Shuttle AI61	MB7901	AMD-750	768	3	Award	100	UltraDMA/66	5		1	MicroATX	1 Yr.	$125	$315	$350	$410	$505	$635	$795	$995	$1415
Tyan S2380 Trinity K7	MB7000	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	6	1	1	ATX	3 Yrs.	$179	$369	$404	$464	$559	$689	$849	$1049	$1469

Socket 370	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video	PCI Slots	ISA Slots	AGP Slot	AMR Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Celeron™ processor 500/A MHz 128K OD 66MHz FSB	w/Intel Celeron 566 128K OD 66MHz FSB	w/Intel Celeron 600 128K OD 66MHz FSB	w/Intel Celeron 633 128K OD 66MHz FSB	w/Dual Intel Celeron 633 128K OD 66MHz FSB	w/Intel Pentium® III 650/667 256K OD 100/133MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 750 256K OD 100MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 866 256K OD 133MHz FSB
ABIT BP6 (Dual)	MB6506	Intel 440BX	768	3	Award			5	2	1		ATX	1 Yr.	$149	$234	$259	$284	$319	$489	N/A	N/A	N/A	N/A	N/A
ASUS CUC2000	MB6724	Intel® 820	1024	4	Award	AC-97		5	1	1	1	ATX	1 Yr.	$177	$262	$287	$312	$347	N/A	$407	$467	$577	$637	$847
EPoX EP-3VCA	MB6854	VIA Apollo Pro 133A	768	3	Award	AC-97		4	1	1	1	ATX	2 Yrs.	$105	$190	$215	$240	$275	N/A	$335	$395	$505	$565	$775
Shuttle ME64	MB6310	Intel 810E	512	2	Award	Intel 810E	Intel 810E	3			1	Micro ATX	1 Yr.	$116	$201	$226	$251	$286	N/A	$346	$406	$516	$576	$786
SuperMicro 370SCD	MB6159	Intel 820	512	2	AMI	AC-97		5		1	1	ATX	1 Yr.	$147	$232	$257	$282	$317	N/A	$377	$437	$547	$607	$817
SuperMicro 370SEA	MB6140	Intel 810E	512	2	AMI	Intel 810E	Intel 810E	6	1		1	ATX	1 Yr.	$146	$231	$256	$281	$316	N/A	$376	$436	$546	$606	$816
Tyan S1857 Trinity 371	MB6017	Intel 440BX	768	3	AMI			6	1	1		ATX	3 Yrs.	$105	$190	$215	$240	$275	N/A	N/A	N/A	N/A	N/A	N/A
Tyan S1854 Trinity 400	MB6018	VIA Apollo Pro 133A	768	3	Award			6	1	1		ATX	3 Yrs.	$104	$189	$214	$239	$274	N/A	$334	$394	$504	$564	$774

Slot 1	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	168-pin RIMM Sockets	Flash BIOS	Integrated Audio	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® 550 512K 100MHz FSB	w/Intel Pentium III 650/667 256K OD 100/133MHz FSB	w/Intel Pentium III 700 256K OD 100MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 750 256K OD 100MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 850 256K OD 100MHz FSB	w/Intel Pentium III 866 256K OD 133MHz FSB	w/Dual Intel Pentium III 550 512K 100MHz FSB	w/Dual Intel Pentium III 750 256K OD 100MHz FSB
ABIT BE6-II	MB6508	Intel 440BX	768	3		Award		UltraDMA/66	5	1	1	ATX	1 Yr.	$137	$332	$367	$427	N/A	$537	$597	N/A	N/A	N/A	N/A
ABIT BF6	MB6507	Intel 440BX	768	3		Award			6	1	1	ATX	1 Yr.	$116	$311	$346	$406	N/A	$516	$576	N/A	N/A	N/A	N/A
ABIT VA6	MB6509	VIA Apollo Pro 133	768	3		Award	AC-97	UltraDMA/66	5	2	1	ATX	1 Yr.	$89	$284	$319	$379	$389	$489	$549	$749	$759	N/A	N/A
ABIT VT6X4	MB6510	VIA Apollo Pro 133A	768	3		Award	AC-97	UltraDMA/66	5	2	1	ATX	1 Yr.	$108	$303	$338	$398	$408	$508	$568	$768	$778	N/A	N/A
Asus P2B-DS	MB6707	Intel 440BX	1024	4		Award			4	2	1	ATX	1 Yr.	$479	$674	$709	$769	N/A	$879	$939	N/A	N/A	$869	$1279
Asus P3B-F	MB6720	Intel 440BX	1024	4		Award			6	1	1	ATX	1 Yr.	$137	$332	$367	$427	N/A	$537	$597	N/A	N/A	N/A	N/A
Asus P3C2000	MB6722	Intel 820	1024	4		Award	AC-97	UltraDMA/66	5	1	1	ATX	1 Yr.	$166	$361	$396	$456	$466	$566	$626	$826	$836	N/A	N/A
Asus P3V4X	MB6723	VIA Apollo Pro 133A	1024	4		Award		UltraDMA/66	6	1	1	ATX	1 Yr.	$118	$313	$348	$408	$418	$518	$578	$778	$788	N/A	N/A
EPoX EP-6VBA2	MB6855	VIA Apollo Pro 133A	768	3		Award	AC-97	UltraDMA/66	4	2	1	ATX	2 Yrs.	$109	$304	$339	$399	$409	$509	$569	$769	$779	N/A	N/A
FIC KA11	MB6411	VIA Apollo Pro 133A	1024	4		Award		UltraDMA/66	5	2	1	ATX	1 Yr.	$99	$294	$329	$389	$399	$499	$559	$759	$769	N/A	N/A
Intel CC820	MB6919	Intel 820	512	2		Intel/Phoenix		UltraDMA/66	5		1	ATX	3 Yrs.	$154	$349	$384	$444	$454	$554	$614	$814	$824	N/A	N/A
Intel SE440BX-2 "Seattle"	MB6921	Intel 440BX	768	3		Intel/Phoenix			4	2	1	ATX	3 Yrs.	$113	$308	$343	$403	N/A	$513	$573	N/A	N/A	N/A	N/A
Shuttle AV64	MB6309	VIA Apollo Pro 133A	768	3		Award		UltraDMA/66	5	2	1	ATX	1 Yr.	$92	$287	$322	$382	$392	$492	$552	$752	$762	N/A	N/A
SuperMicro P6DGH	MB6129	Intel 440GX	2048	4		AMI		Adaptec 2-Ch U2W	9	2	1	Full AT	1 Yr.	$829	$1024	$1059	$1119	N/A	$1229	$1289	$1489	N/A	$1219	$1629
SuperMicro P6SBA	MB6120	Intel 440BX	768	3		AMI			4	3	1	ATX	1 Yr.	$104	$299	$334	$394	N/A	$504	$564	$764	N/A	N/A	N/A
SuperMicro P6SBU	MB6128	Intel 440BX	1024	4		AMI		Adaptec U2W	4	3	1	ATX	1 Yr.	$329	$524	$559	$619	N/A	$729	$789	$989	N/A	N/A	N/A
SuperMicro PIIIDM3	MB6153	Intel 840	4096	4		AMI	AC-97	Adaptec Ultra3/160	6		1	ATX	1 Yr.	$579	$774	$809	$869	$879	$979	$1039	$1239	$1249	$969	$1379
SuperMicro PIIIDME	MB6151	Intel 840	4096	4		AMI	AC-97	Intel PRO/100+	6		1	ATX	1 Yr.	$359	$554	$589	$649	$659	$759	$819	$1019	$1029	$749	$1159
SuperMicro PIIISCD	MB6146	Intel 820	512	2		AMI	AC-97	UltraDMA/66	5		1	ATX	1 Yr.	$152	$347	$382	$442	$452	$552	$612	$812	$822	N/A	N/A
SuperMicro PIIISED	MB6142	Intel 810e	512	2		AMI	AC-97	UltraDMA/66	6			ATX	1 Yr.	$123	$318	$353	$413	$423	$523	$583	$783	$793	N/A	N/A
Tyan S1854 Trinity 400	MB6018	VIA Apollo Pro 133A	768	3		Award		UltraDMA/66	6	1	1	ATX	3 Yrs.	$104	$299	$334	$394	$404	$504	$564	$764	$774	N/A	N/A

Slot 2	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Controller	Integrated Networking	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® Xeon™ 550MHz 512K 100MHz FSB	w/Intel Xeon 550MHz 1M 100MHz FSB	w/Intel Xeon 550MHz 2M 100MHz FSB	w/Dual Intel Xeon 550MHz 512K 100MHz	w/Quad Intel Xeon 550MHz 512K 100MHz	w/Intel Xeon 700MHz 1M 100MHz FSB	w/Intel Xeon 700MHz 2M 100MHz FSB	w/Intel Xeon 800MHz 1M 100MHz FSB	w/Intel Xeon 800MHz 2M 100MHz FSB
SuperMicro S2DM3	MB6156	Intel 840	4096	4	AMI	AC-97	Adaptec Ultra3/160m	Intel PRO/100+	6		1	ATX	1 Yr.	$669	$1769	$2999	$5009	$2869	N/A	$2069	$3019	$3039	$5069
SuperMicro S2DME	MB6160	Intel 840	4096	4	AMI	AC-97		Intel PRO/100+	6		1	ATX	1 Yr.	$449	$1549	$2779	$4789	$2649	N/A	$1849	$2799	$2819	$4849
SuperMicro S2DG2	MB6136	Intel 440GX	2048	4	AMI		Adaptec 2-Ch U2W		5	2	1	ATX	1 Yr.	$549	$1649	$2879	$4889	$2749	N/A	N/A	N/A	N/A	N/A
SuperMicro S2QR6	MB6190	Reliance HE	16384	16	AMI		AIC-7899 2-Ch Ultra160	Intel 82559	8			SWTX	1 Yr.	$2749	$3849	$5079	$7089	$4949	$7149	$4149	$5099	$5119	$7149

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1 Source → 1 Target

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- Reverse data transfer - clone from target to master
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features - data recovery, drive wipe, and scanning
- Clone both ways thru a parallel port connection
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Solitaire
852MB/MIN
CLONE NOW

$845
HDP500

1 Source → 2 Targets

OMNICLONE REPLIQUE 2

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HDP501

The OmniClone Replique 2 is the most portable way to copy to two native target drives.

- Dual target, IDE hard drive to hard drive duplication
- Compact—Smallest unit on the market
- Data transfer speeds exceed 800 MB/min
- Durable design—Metal case and heavy-duty removable hinge
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
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- Easily upgraded to Replique 5 with the Replique 2 Expansion Station (Targets 3,4 & 5) (*HDP502*) for $1795.00

1 Source → 5 Targets

OMNICLONE REPLIQUE 5

$3,650
HDP503

The Replique 5 package is a complete one-to-five solution, just plug it in and clone!

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- Compact—Smallest unit on the market
- Data transfer speeds exceed 800 MB/min
- Durable design—Metal case and heavy-duty removable hinge
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
- Modular—If one unit fails, you still have a 1 to 2

3 Sources → 15 Targets

OMNICLONE REPLIQUE 15

$8,995
HDP505

OmniClone Replique 15 clones up to 15 drives at once. The units can be detached and reassigned to fit workload needs. Comes with space saving docking station with sliding ball-bearing shelves.

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- Compact—Smallest unit on the market
- Data transfer speeds exceed 600 MB/min
- Durable design - Metal case and heavy-duty, ball bearing slides
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
- Modular—If one unit fails, you only lose two targets

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Replique 5 OmniDiagnose *HDP515*	$395.00
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Replique 10/15 NTFS Clever Copy *HDP519*	$395.00
Replique 10/15 OmniDiagnose *HDP520*	$395.00
Replique 10/15 Clone Pack (includes all options) *HDP521*	$1295.00
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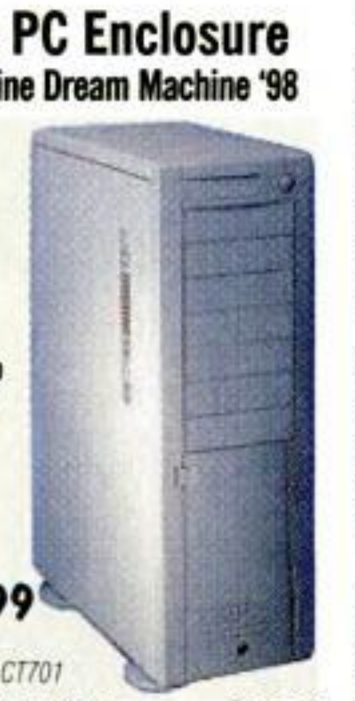

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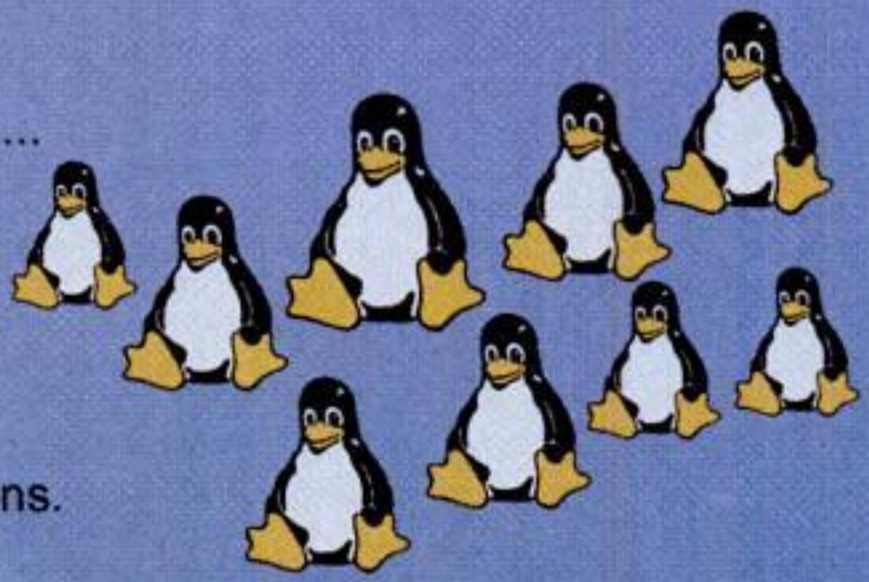

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9.1GB	2MB	7,200	IBM309170W	$225
18.2GB	2MB	7,200	IBM318350W	$335
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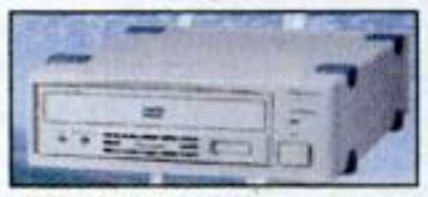
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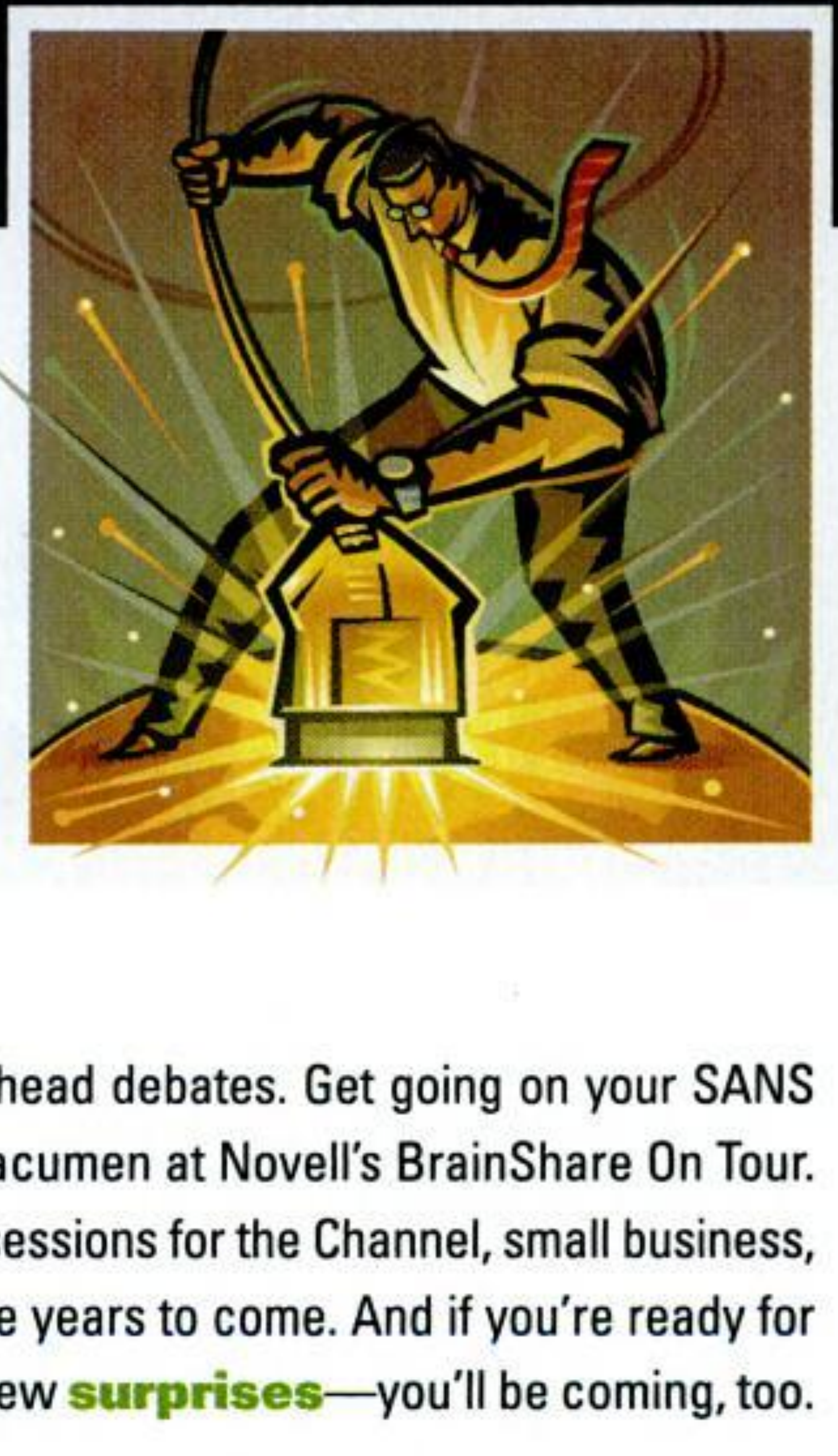

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BY JON PHILLIPS

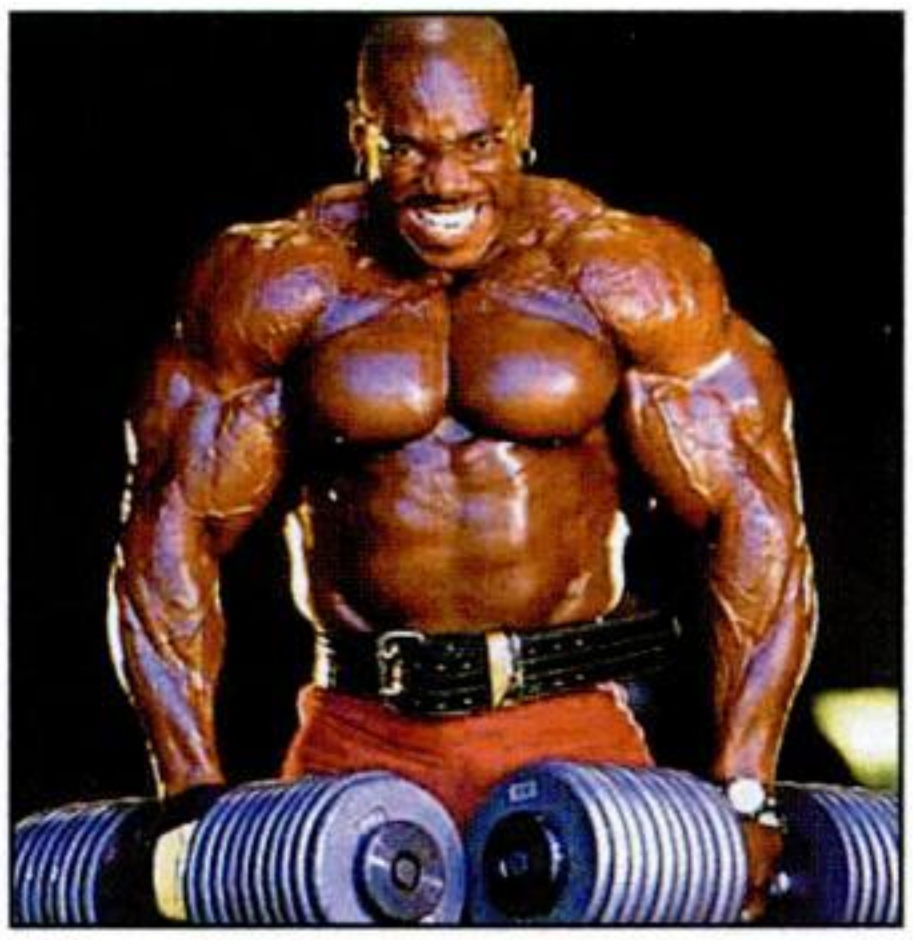
TOTALLY ANABOLIC!

Gigahertz Gainer 2100

The first low-latency, high-conductivity performance shake for the x86 processor family. It helped Flex Wheeler place first in this year's Hungarian Grand Prix Muscle Challenge, so it SURELY must boost clock frequency when poured liberally into the open fan ducts of the typically feeble family PC. We're not talking 100MHz, 1000MHz, or even 2000MHz. We're talking speed gains of up to 2100MHz!!! Can you hang, little man? If not, then go knit yourself a mouse cozy, because your CPU is going to hit the zenith of silicon hypertrophy, whatever arbitrary "speed rating" is printed on the side of its cartridge notwithstanding.

So what's the secret? It's the whey! That's right, the ultra-high protein fluid that separates from the curd in coagulated milk. Little Miss Muffet got jiggy wid'it, and now your CPU can get giggy wid'it. Our formula starts with ionized whey, purified with membrane filtration, and then we add ISO8796, a silicon isolate pure enough to be used in industrial application. We then add some random peptides and alpha lactoglobulin. Mmmmm—lactoglobulin! That's what makes the 2100 taste so good!

You want fast? Get ready to go WHEY fast!

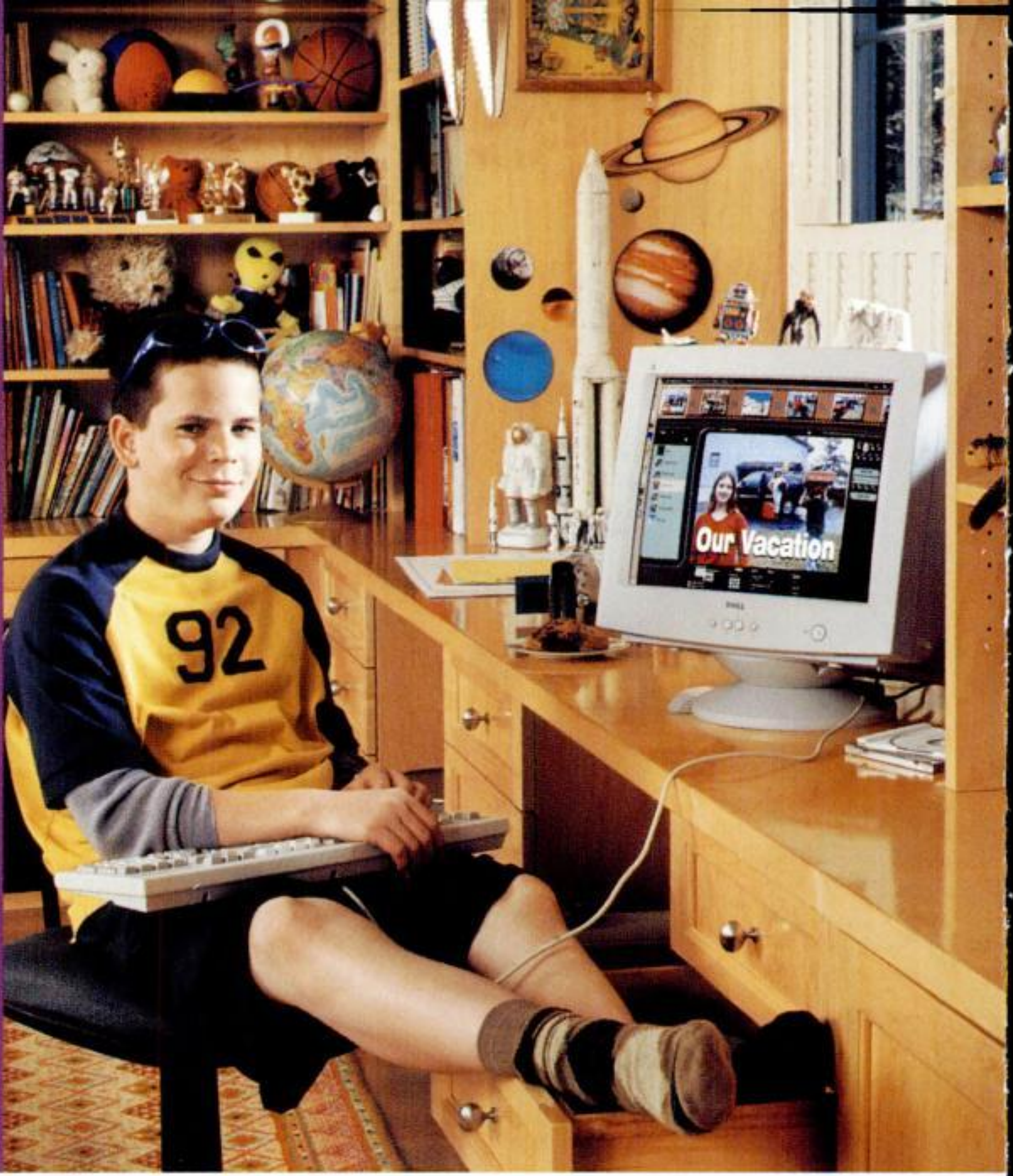


Flex Wheeler: "I used the organic version of Gigahertz Gainer 2100 to win the Hungarian Grand Prix. As for the silicon version, I have reservations about its safety and integrity. "

Nicole Bass: "I once dated a computer nerd. But then he started getting grabby with me, so I crushed him to death with my thighs, and ate him as part of my protein stack."

Manfred Hoeberl: "I don't care about CPUs, and I don't care about Gigahertz Gainer 2100. All I care about are my massive, freaky guns. Massive, freaky! Massive, freaky! Arghhh!"

17 hours of our trip to Mt. Rushmore edited down to 4 thrilling minutes.



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